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Night Roundhouse Foreman

"I dropped into a roundhouse having 12 stalls the other night and asked for the foreman. They told me that he had gone home at seven o'clock and would not be back until seven the next morning. I then asked to see the man who was in charge of the house and was surprised to discover that there was no one in charge. There was a hostler foreman, a couple of machinists, a fire-up man and a couple of handy men, but none of them had any authority over the others. On investigation I find that this is not an unusual condition for small houses of this kind. It does not seem to be a good policy to me."

The above is an extract from a letter recently received. The instance is probably quite typical and it certainly does not seem to be a good policy. If a roundhouse is of sufficient importance to require a foreman in the day time why should it not also have at least an assistant foreman or someone designated to be responsible for its operation during the night time? Engines have to be turned in the night as well as in the day and conditions for working are much harder, the class of help is usually not as reliable, emergency supplies are difficult to obtain, the opportunity for trouble, often of a serious nature, is greater and the train despatchers are certainly no more patient. How many roundhouses have you on your road where there is not a responsible person in charge during the night?

Six Wheel Tender Truck

It has been the practice of the Santa Fe for some time past to apply six wheel trucks to all high speed passenger equipment whether the weight of the car demanded them or not. This move is believed to be justified in the interest of safety if for no other reasons. Six wheel trucks under locomotive tenders, however, have never seemed to be a necessity and their use under the tenders of 32 Pacific type locomotives, recently completed for the Santa Fe, is an interesting departure. This company, however, has had experience with six wheel tender trucks in the case of the Mallet type passenger locomotives which were built a number of years ago. The truck for the Pacific type is illustrated on page 506 of this issue and has a cast steel frame in one piece with cast steel pedestals bolted to it. The bolsters are suspended on heart shaped links which are pinned to the transverse sections of the truck frame. The links, however, are unsymmetrical, the outside upper pin in each being vertically above the lower pin. It is believed that since with this method one side of the bolster will be raised higher than the other when the truck is displaced on the curve, the stability of the tender will be increased and a more even distribution of the weight on the track be obtained. The Santa Fe is practically the only system which has found the balanced compound passenger locomotive to be a success, and in addition to a large number of Atlantic type engines of this cylinder arrangement it now has 80 Pacific type locomotives with inclined high pressure cylinders. The latest order also includes 29 Mikado type locomotives which are the first of this design to be put in service on this road. By careful attention to the use of standard parts or parts which, at least, are common to a number of other type locomotives, the usual difficulties and expense which accompany the introduction of a new type on any system will be greatly minimized in this case.

Master Painters' Association

The forty-fourth annual convention of the Master Car and Locomotive Painters' Association was marked by the consideration given to the painting of steel cars. Several of the members called attention to the fact that engine tenders had been painted and satisfactorily maintained for a long time, and expressed surprise at the difficulties experienced on the steel car equipment. While the engine tank and the steel car may be comparable in some respects it is plain that the steel freight car is subject to much more severe treatment and the steel passenger car requires a more elaborate finish.

The painting of steel cars by the baking process, as described by John Gearhart, of the Pennsylvania, was received with some degree of skepticism by many of the painters, even though the results thus far obtained have been very satisfactory. This process not only allows a car to be finished in a much shorter time, but also permits of a paint containing no special drying agent, which is claimed to materially increase the life of the paint. A question was raised as to the removal of this baked paint. There was no definite information on this point, and when these cars are shopped for repainting it will be interesting to learn of the procedure followed.

As regards locomotive painting it seems to be the general opinion of the master painters that the present so-called economical methods are grossly extravagant. It is believed that with more time, more paint coats and with better material a locomotive can be painted at a decrease in ultimate cost, because the finish will last much longer, the cost of maintenance will be materially decreased and the engine will have a much more attractive appearance.

While the convention as a whole was a successful one, the lack of a thorough discussion of all the papers presented should be mentioned. Three or four subjects received a very thorough discussion, but there were others that were passed with only the presentation of the report. In order to obtain the greatest good from a subject it should be thoroughly discussed; and if for any reason it cannot be discussed, it should not be presented at that time. Furthermore each member having anything constructive to offer should not hesitate to give his information. If an author of a paper knows that his paper is to be closely analyzed, he will of necessity make a closer study of the subject assigned to him, and present a much more able paper in order to protect himself. In assigning the papers care should be taken that the authors are fully capable of handling the subjects, and they, in turn, should exert their best efforts to make their paper the best one presented. In this way the good reputation of the association will not only be maintained and advanced, but its prominence amongst the railway mechanical associations will grow, and the value of its work to the trade will be recognized by those in authority.

Railroads and College Men

A correspondent, whose letter is printed in this issue, gives his ideas of the reasons why so few college trained men remain on the railroads. While what he has to say may be true in many cases, does the whole fault lie with the railroads?

The colleges have a responsibility in this connection which should not be overlooked. Are they generally accepting it and supplying the kind of training that will permit their graduates to enter the railroad field with as good an equipment as is supplied for other fields of endeavor? So far as the mechanical department is concerned, and it is particularly this department that our correspondent refers to, the indications are that with but two notable exceptions in the United States and possibly one in Canada, the colleges where mechanical engineering is taught at all are making but slight effort to give their students the kind of training that will prepare them to compete on the railroads with men of similar mental caliber who have come up through the ranks. To be sure, the graduate's personality enters very materially into the question and it is difficult to make comparisons, but the result of an examination of the college trained men who have made distinct successes in the mechanical department will show so great a predominance in favor of a few colleges where more or less special attention has been given to a preparation for railroad work, that the indications are conclusive that such a preparation gives the man a decided advantage. It is by no means certain that a special training, confined exclusively to railroad subjects is the best for the future success of the graduate, but instruction in how to apply engineering principles to the solution of the peculiar and special problems met with in locomotive and car design, operation and repair, appears to be sadly lacking in most mechanical engineering courses. A college would be failing in its duty if it gave the degree of mechanical enginer with a training in the application of engineering principles to the railroad or any other single field. On the other hand, it is equally failing in its duty to the railroads of this country if it gives its students no opportunity of learning how to apply the same principles to railroad problems as well as those found in stationary practice, the electrical field, or general manufacturing. The railroads need college trained engineers and no one realizes that better than the responsible officers in the various departments. But is it surprising in view of the experience of the past, that they cannot see their way clear to make any special inducement to them? There is no field which at the present time offers a more attractive future to a properly trained mechanical engineer who has suitable personal characteristics and a sound character than will be found in the mechanical departments of our railways. To be sure, they will have a much harder path to follow than they probably should have, due to the disappointing experience with their predecessors, but those who have the stamina to overcome the obstacles and the ability to make up for the shortcomings in their training while in college in case they are unfortunate enough to come from those colleges which are weak in this regard, will find that the reward is well worth striving for and at thirty or thirty-five years of age they will be commanding a larger salary and be in a much better position than their classmates who, in other lines of work, seemed to be far above them at twenty-five.

Freight Car Troubles

Better maintenance of freight cars is one of the most important, if not the most important, problem now before the mechanical department. J. C. Fritts, master car builder, Delaware, Lackawanna & Western, in his paper at the September meeting of the Central Railroad Club, makes some very excellent suggestions and offers some sound practical advice for improvement in this direction. He analyzes the whole situation and reaches the same conclusions other investigators have reached, that the draft gear and its attachments are the principal cause of the trouble. While it is the older and weaker cars that fail most frequently, some of the recently built equipment is proving a source of considerable trouble because of poor design. Mr. Fritts believes that, with the proper repairs, much of this older equipment can be kept in service with a moderate cost of upkeep for a number of years. Where a car has an expectant life long enough to make the expense advisable, he suggests the application of a complete steel underframe. In cases where so large a cost does not seem to be justified he recommends the application of steel draft sills which extend through and over the body bolster and are backed up with good heavy compression timbers. F. F. Gaines, superintendent of motive power, Central of Georgia, in his analysis of this same subject which was published on page 205 of the April issue of this journal, shows that on his road 38.91 per cent. of the cost of freight car repairs was due to the draft gear and its attachments. Following this analysis he put in practice the scheme which is now again recommended by Mr. Fritts, and applied metal draft arms engaging the steel body bolster to a number of wooden coal cars which were being rebuilt. This extended well back of the body bolster so as to reinforce the center sills and was applied in connection with a substantial friction draft gear. These cars went in service and after three years they showed no cost for repairs of couplers or draft gears. One of them was in a collision on a foreign road and when returned had the eight longitudinal sills and the side planks broken, but there was no damage whatever between the center of the car and the end, including the draft gear. This experience would seem to conclusively prove the value of Mr. Fritts' suggestion. It will be noticed that Mr. Gaines applied friction draft gears to the cars rebuilt at that time and Mr. Fritts strongly urges the same action. He gives, in his paper, an analysis of the comparative service for a period covering twenty-six weeks between various types of spring gear and various types of friction gear. The report covers spring gears on 15,000 cars and friction gears on 4,805 cars. It was compiled from weekly reports submitted by inspectors and shop foremen at every point on the Delaware, Lackawanna & Western where repairs were made, and shows that spring gears failed on 81 per cent. of the cars during this period, while with the friction gears there were failures on but 17 per cent. These failures included broken couplers, knuckles and knuckle pins, pockets and pocket rivets, followers, springs and draft spring castings, and in view of the fact that most of the spring gears were applied to wooden cars, which to a certain extent form a cushion themselves and protect the gear, the indications seem to be most conclusive in favor of the friction gear. Mr. Fritts makes a most excellent suggestion that there be formulated some standard specification which could be adopted for the testing of draft gears before purchasing in order to know something of their value in connection with the shock absorbing capacity and the amount of recoil. Expense of maintenance of the car roof is not overlooked and the author recommends that the present wooden roof be supplanted by an all-metal one as soon as it has been demonstrated what the proper construction should be.

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It will be remembered that at the last convention of the Master Car Builders' Association there was considerable discussion over the elimination of 40,000 lbs. and 50,000 lbs. capacity cars in interchange. This was finally disposed of by the appointment of a committee to obtain from each member of the association a statement as to the situation from its viewpoint and ascentain if it would be possible to make recommendations to the American Railway Association for the setting aside of older cars. This committee has been appointed and D. F. Crawford, general superintendent of motive power, Pennsylvania Lines West of Pittsburgh, Pittsburgh, Pa., is the chairman. It is difficult to see the direct relation between the capacity of a car and its strength for resisting shocks, and it is quite probable that this committee will take the broad view of the situation and not follow the lines indicated by the title of this subject. Mr. Fritts suggests that the question is one of draft gear, draft timbers and buffing arrangements, much more than capacity or even age. What is desired is strong cars, not necessarily high capacity cars, and if this committee can recommend a minimum strength requirement which will govern the interchange of cars, it will perform a most valuable service.

NEW BOOKS

Master Boilermakers' Association Proceedings of the Seventh annual convention. Bound in paper. 6 in. x 9 in. 174 pages. Illustrated. Published by the Association, H. D. Vought, Secretary, 95 Liberty St., New York. Price $1.00.

A condensed report of the 1913 convention of this association appeared on page 314 of the June issue of the *American Engineer*. The volume of Proceedings, however, contain the verbatim account of the discussion, together with the full text of all of the papers presented and of the addresses which were delivered before the meeting. Papers on length of tubes without midway support; weak and unsafe condition of boilers; best method of welding the superheater tubes; effect of superheaters on the life of the firebox and flues; inspection of boilers; best forms of grate; applying and caring for flues; chemically treated feed water and advantages of oxy-acetylene and electric welding for boilers were discussed. The Proceedings contain a list of the members and their addresses, the membership of the committees for the following year, and the subjects that will be discussed at the next convention.

Smoke and Smoke Prevention, Bibliography of. Compiled by Ellwood H. McClelland, Technology Librarian, Carnegie Library of Pittsburgh. Bound in paper. 164 pages. 6 in. x 9 in. Published by the University of Pittsburgh, Pittsburgh, Pa. Price 50 cents.

This pamphlet is Bulletin No. 2 of the Mellon Institute of Industrial Research and School of Specific Industries. It includes an extensive list dealing mainly with coal smoke, but does not include the literature on dust, fumes and other subjects more or less directly related to the suppression of smoke. Titles and quotations are given in the original, regardless of variations in spelling. Each reference gives the date of publication, shows the extent and method of illustration and indicates the length of the article either in words or by inclusive pages. Titles and sources are given in full. This includes reference to all foreign publications as well as those in the English language.

Engineering Education. Proceedings of the twentieth annual meeting of the Society for Promotion of Engineering Education. Bound in cloth. 508 pages. 6 in. x 9 in. Illustrated. Published by the Society, H. H. Norris, Ithaca, N. Y., secretary. Price $1.25.

At this meeting there were a large number of papers and addresses presented by the leading engineering educators in the country on subjcts connected with the improvement of engineering education. The assigned subjects, on each of which there were several reports and considerable discussion were: The Teaching of Elementary Physics, the Training of Engineering Teachers, the Efficiency of Engineering Education, Engineering Laboratories, Entrance Requirements for Engineering Schools, Industrial Education. Among the papers presented were a number descriptive of engineering laboratories and apparatus, of methods which have proven satisfactory in the teaching of various subjects and of the proper use of some of the recently perfected testing instruments.

International Railway Fuel Association. Proceedings of the fifth annual convention. Bound in paper. 315 pages. 6 in. x 9 in. Illustrated. Published by the Association, C. G. Hall, 922 McCormick building, secretary. Price 50 cents.

The proceedings of this association form the best single source of information concerning the use of fuel on railways. While most of the deliberations are confined to a discussion of coal, including the mining, handling and use, liquid and gaseous fuels are also given some attention. In fact, at one of the recent conventions the most extensive and important paper presented was entirely confined to the discussion of fuel oil and its use on locomotives. At the fifth convention papers were presented on the following subjects: Construction, Development and Operation of a Bituminous Coal Mine, Firing Practice, Modern Locomotive Coaling Station, Scaling of Locomotive Boilers and Resultant Fuel Loss, Self-Propelled Railway Passenger Cars, Standard Form of Contract Covering Purchase of Railway Fuel Coal, Sub-Bituminous and Lignite Coal as Locomotive Fuel. A beginning was made at this meeting in preparation of a standard manual of firing practice which eventually will probably prove a most important and valuable basis for instruction of locomotive firemen. The proceedings include the full text of the papers and the verbatim account of the discussion, together with a copy of the constitution and by-laws, a list of the members with their addresses as well as a list of subjects from which those to be discussed at the next meeting will be selected.

Water, Its Purification and Use in the Industries. By William Wallace Christie. Bound in cloth. 212 pages 5¼ in. x 7¾ in. Illustrated. Published by D. Van Nostrand Company, 25 Park Place, New York. Price $2.00.

The purification of water is treated in this book more from an industrial standpoint rather than for drinking purposes, although the latter use is also considered. It gives a comprehensive treatment of the apparatus and methods of purification, presenting all available data from a technical rather than from the commercial viewpoint. In the first chapter the sources of water, its impurities, uses and reagents used for softening, are considered and the next two chapters are devoted entirely to water softening, the second one discussing the cold process and the third, the hot process. Results accomplished by softening systems are considered in the fourth chapter, while the fifth discusses pressure filters. Following this are chapters on aeration, sterilization, measurement, oil filters for boiler water, purifying drinking water, etc. Many tables of value to users of water for manufacturing or industrial purposes are included. The book is illustrated with drawings and phantom views of the various apparatus used in this connection.

Locomotive Boiler Construction. By Frank D. Kleinhans. Additions by Geo. L. Fowler. Illustrated. Bound in cloth. 462 pages. 5½ in. x 8 in. Published by Norman W. Henley Publishing Company, 132 Nassau street, New York. Price $3.

Presentation of theoretical matter has been avoided as far as possible in this book. The best and most rapid methods of the large builders and railroads have been given and new untried methods or designs have been avoided. The author states that as the different operations on the different makes of boilers are so similar to each other, it has been considered best to devote a section to the description of boilers in general. This section only covers five pages and following it the locomotive boiler is taken up in the order in which material goes through the shop. It begins with the laying out of the sheets and gives the necessary information that will enable a boilermaker to lay out the different parts of the boiler. In some cases several methods, each best suited to certain conditions, have been explained. Following this there is a section on shearing and one on flanging. The next operation is the punching or drilling of holes and preparing the edges for calking. The next operation considered is that of bending, following which there is a section on assembling and calking and then one on details. Boiler shop machinery has also been allotted a section of the book, and an attempt has been made to show the points of machines which are liable to become broken through carelessness. Instructions are included for keeping the machines in good running order and how to make necessary repairs. The testing of boilers is allotted a chapter and the last section is devoted to a group of useful tables which are intended to include all the matter that is necessary in connection with the construction of a boiler, together with the stresses which are set up in the various members due to the steam pressure and expansion. A number of folding plates showing several different types of modern locomotive boilers in detail are included at the end of the book. Difficult designs have been selected for these drawings with the idea that a person who has become capable of laying out and following the sheets shown through the shop would have no difficulty in handling any boiler made.

Factory Lighting. By Clarence E. Clewell. Bound in cloth. 156 pages. 6 in. x 9 in. Illustrated. Published by McGraw-Hill Book Company, 239 West 39th St., New York. Price $2.00.

Examples can be seen on every side, that a large amount of artificial light does not necessarily mean good lighting. Mistakes, due to ignorance of the principles of good illumination, have been frequent in otherwise perfectly appointed shop buildings and offices. There is no doubt that good lighting is an aid to accurate workmanship and manufacturing output, and contributes to a large extent to a reduction in manufacturing cost. The author of this book has been engaged in the design and supervision of the installation of lighting systems for a number of years, and aims to tell how to obtain good lighting and to tell it in a simple way. The experiences of actual installations are made the basis for analysis and explanation throughout the book. Actual results are given precedence over generalized statements. The office, the drafting room and the power house have been given consideration as well as the shop itself. One chapter is devoted entirely to machine tool lighting and the insignificance of the cost of adequate lighting for machine tools is illustrated by the statement that the energy and maintenance of an individual electric lamp amounts to 25c. a month, while the operator who depends on the lamp receives $3 a day. Therefore, the cost of the lamp is equal to the wages for two minutes each day, and if the better illumination will save the workman that amount of time it is a paying investment. Photographs are freely used to emphasize the facts explained in the type and drawings of typical installations are included.

Rules of Management. By William Lodge, president of the Lodge & Shipley Machine Tool Company. Bound in cloth. 140 pages. 5 in. x 8 in. Published by the McGraw-Hill Book Company, 239 West 39th St., New York. Price $2.00.

In his foreword, Mr. Lodge states that when he decided to relinquish the active management of the Lodge & Shipley Machine Tool Company and let a younger generation take up the reins, he realized what would probably happen if he simply handed them over to others who had never learned how to drive. He, therefore, endeavored to see what could be done to prevent the immediate development of a new set of conditions with which the organization he had built up would not be able to cope. In carrying out his plan of teaching the subordinates to handle things, the record of his personal experience, put in the form of rules and comments, was printed for the information of the succeeding manager of the shop. This work is the result of the desire to give, in a permanent written form, a knowledge of facts and scheme of organization that would enable the next manager to carry on his work with a feeling that he was on sure footing on the ground over which he must travel. These instructions may also be found applicable in many lines of machine building and they have therefore been published for general distribution. In this book the duties and work of each department are outlined in some detail and there are separate chapters for each class of employees from the general manager to the janitor and watchman. These rules and instructions throughout are excellently worded, tempered with common sense and are thoroughly practical in their application. Although intended for the machine building industry, the principles of good management in the abstract are so well understood and have been so thoroughly interwoven throughout the whole series of instructions, that they are applicable to practically any manufacturing activity.

COMMUNICATIONS

GRINDSTONE AT RIP TRACK

ASHLAND, Ky., May 26, 1913.

TO THE EDITOR:

The freight car rip track at the Ashland shops of the Chesapeake & Ohio is nearly half a mile from the main shop, and, while we have an air line running to it to supply 90 to 100 lbs. pressure for small pneumatic tools, testing, etc., it was necessary to bring the edge tools and saws to the shop for sharpening. To save this lost time we rigged up the arrangement shown in the illustration. It consists of a reversible air drill and a steel shaft, turned at one end to fit the socket of the drill and squared at the other end to fit the hole in a grindstone. The boxes or spools used for bearings are cast iron with a brass bushing

Reversible Air Motor Temporarily Driving a Grinding Wheel.

pressed in and bored to fit the shaft. They rest on oak blocks and are held by ¾ in. U-bolts. The same form of bolts is used to hold the air drill to the bench.

When it is desired to use it, the device is rigged up on one end of the work bench in the carpenters' shed. The shaft and its attached parts are stored when not needed, and the air drill is used in regular work.

This arrangement will be found very satisfactory when using a grindstone 18 in. in diameter or less. Also on small emery wheels for sharpening cross-cut saws. We have the latter mounted on a separate shaft, all other parts being used as shown.

W. P. HUNTLEY,
General Foreman.

CAR WHEEL FLANGES AND TREADS

PITTSBURGH, Pa., September 10, 1913.

To the Editor:

Referring to a series of experiments with wheels under loaded single trucks as described in the September issue. Prof. Wallace deserves a great deal of credit for giving us something to think about. Some of his results check very accurately with the long accepted theories and the experiences obtained by the different railroads for the last fifty years, while others do not. Therefore, it may not be amiss to reflect briefly on each item brought out by Mr. Wallace.

Cone of the Tread.—The figures show very conclusively that the cone is essential. It, of course, compensates for the difference in length of the rails on curves and on tangents it keeps the flanges from continually hugging one rail or the other, and it is for this very reason that the increase in taper from 1 in 32 to 1 in 20 has produced improved results.

Mating of Wheels on One Axle.—Mr. Wallace obtained on badly matched wheels (B) much better results than on mated ones (A), and on the 3 deg. curve (D and E) obtained about equal results, although one set was exactly mated and the other one ⅝ in. out, with the larger wheel on the inside rail at that. It is self-evident that these figures contradict all fundamental and accepted principles and must be due to some differences in outside conditions. It looks as if the readings on wheel A are entirely out, so that the author is entirely justified to conclude contrary to what the figures show.

Mating of Wheels as Pairs.—It is very strange that a difference of 1/16 in. in mating between the front and the rear pair (each pair properly mated) should have any influence on the resistance, and in spite of this Mr. Wallace found (set A) a difference of over 6 lbs. on a 12 deg. curve in favor of having the large wheels leading. This again points towards some irregularity not accounted for.

Location of Large Wheel.—The figures show that the resistance drops whenever the larger wheel is located on the outside rail and vice versa. This is natural, as the larger circumference then runs on the longer rail, and the conditions are more nearly as they exist on a tangent.

Material.—The rolling resistance depends on the smoothness and the hardness of the wheels. Wheels A and C were both ground so the hardness was the only one item left to affect the result. Mr. Wallace found that the chilled iron wheel showed about twice as much resistance as the cast steel one, which again points to some irregularity in the performance of the set A, and inasmuch as the difference was actually 5 lbs. on a tangent as well as on the curves, the discrepancy must be looked for in a difference of the journal friction.

It is, of course, well understood that the friction found on these single trucks is not train resistance properly, as so many other items enter into that question. It is also likely that some of the items under consideration will show up differently as soon as the trucks are put under a car. None the less, the figures so far obtained are very interesting and Prof. Wallace deserves thanks for starting this work.

A. STUCKI.

WHY DON'T RAILROADS HOLD THE COLLEGE MAN?

CHICAGO, Ill., September 10, 1913.

To the Editor:

"About 2 per cent. of the college men we employ stay with us," reports a motive power man on one of the big trunk lines. Scan the records of any road taken at random or any number of roads; note the number and names of the college men entering the service of a road and follow them through—one, two, five years, and in nine cases out of ten it will be found that, at the end of five years, only about 10 per cent. remain. Although they know this condition, few officials have done anything to correct it. Why do the college men leave railroad service, especially in the motive power department? They are better taken care of during slack times than the rank and file in other activities, they are shown every courtesy, and given every opportunity to advance while learning. Yet they leave; some in two or three months, others in two or three years.

The reasons are many, but usually simple, and it is surprising how little is done to hold the college trained man. Take the man, for instance, who enters the motive power department. He is usually a graduate in mechanical enginering and decides to become a special apprentice. Without casting any reflections on the piece work system, it is generally a fact that if he enters a piece work shop he is decidedly unfortunate and his time is practically wasted. This is borne out by unsolicited statements of the men themselves. There is only one way to teach a man to do things—have him do them! A machinist or other skilled laborer in a piece work shop is busy, far too busy to have time to show some one else how to do the work properly; he not only does not have time, but he can't and won't afford it. Every minute taken from his work means just so much from his pay envelope. Go through a piece work shop and you can doubtless count on the fingers of one hand the number of apprentices running big machines. In the parlance of the shop, "they don't get a show." To be sure, they are allowed to stand by and be helpers, hold a brush and help transfer work to and from floor and machine; they can ask all the questions they wish and gain much useful knowledge, but will they be able to handle tools intelligently? Can they tell others how they want a thing done? Hardly. These are conditions as they exist in one of our biggest railroad shops in Pennsylvania, and the apprentices spend four years at it too. Is it any wonder that some of them leave rather than be a "brush holder" for four years? They obtained more actual machine work in college, and ran the tools themselves.

In Chicago is another very large shop, run by a western road—a "closed day rate" shop—no piece work. Special apprentices as well as regulars enter this shop; are assigned to a certain gang machinist (if on the floor) or lathe, generally a bolt lathe first. In less than a week they will be running that machine under the supervision of an apprentice instructor having been first broken in by the apprentice that preceded them. And so it goes in every department; they are taken right in hand, and lay off shoes and wedges, set valves, hang link motions and so forth, and do it themselves, as well as the machinist who taught them. They are moved from one job to another, getting a real chance to learn, with the result that they know tools at least, and can step into a foreman's position with the assurance that they at least know what the men under them are doing. This particular shop has a three year course for specials and four for regulars. Three years in a day shop is enough, but four, or even six in a piece work shop does not equal it in many cases.

Follow along with the men who have "stuck" through the apprentice course. The percentage who finish in the day rate shop is generally smaller by far than in the piece work shop. This at the start is a big advantage, both to them and the company, for the very reason that the work they *personally* do is real hard work, as hard and exacting as the work of the men they work under; they are not mere helpers and observers, but workers in every sense of the word. It is this hard work that weeds out the "collar and cuff" crowd who would rather sit at a desk and "push a pen" than get greasy and dirty. This class is weeded out in the first two or three months and no one is the loser. Then there is the ambitious few who have served, say two years of their time; they do their work well and are well liked. Some go home on vacations, or go here and there on business for the company and meet men, fellow classmates of theirs who are in industrial lines. These men are making, on an average, *more than twice as much* as the railroad man is, are being steadily advanced, and have an assured success before them. Yet they left college at the same time as the railroad apprentice, who still has one or two more years before him at a laborer's wage! What is the result? Is it any wonder that 50 per cent. quit at the first opportunity and go into other fields? Can they be blamed? The railroads, however, seem content to let this big majority go by after training them for so long. No inducements are held out—they don't seem to think it is capital gone to waste.

The way to hold these men is to cut the apprentice course for them to two years. Any man who is a graduate mechanical engineer, if he is any good at all, can with the right system get all that is necessary out of the shops in two years. Yet the Union Pacific is the only road to my knowledge that has realized and profited by this fact. There are men (and you can see them every day) in one of our big piece work shops in Pennsylvania, both special and regular apprentices, who have served their four years, yet cannot swing a hammer properly or chip out a stud; they can be seen standing at a bench in the shop practically "pushing" the hammer, and this after four years training.

To get back to the subject, the few men who finish their time in the day shops are at once made machinists, and after two or three months more are made assistant roundhouse foremen, assigned to special duty or some similar position paying from $100 to $125 a month. Four years in college and three or four more in the shops; seven or eight all told. They, after all these years of preparation, are getting as much as a good bookkeeper, clerk or draftsman who in many cases stepped into these positions right out of high school, or after a few months of business college. They have a bank account, and are bringing up families, while the prepared college man is only earning a few cents an hour.

One road makes a specialty of turning its "shop graduates" into the test department, where they don't get even as much as the machinists in the shops. After eight years of study and preparation they can get more for their muscle than for their brains! They are given work far beneath their capabilities; odd drafting jobs, computing and tabulating road tests, shop tests, etc., things that wouldn't tax the mind of a high school graduate; things that are not even worth the salaries they are paid. Yet they are kept on the pay roll, thrown a sop in the form of a title, and so it goes.

I have pointed out the faults—what is the remedy? Simply this: If you do have an apprentice course for college graduates, make it for *two years*—no more. Have special instructors and machines for your apprentices, make them work *all* the time they are on bench, machine, floor, and in the roundhouse, and get all there is to be gotten out of it. See that they are able to run their lathes, planers, shapers, etc., themselves, have them turn out work and compete with the other machinists. A schedule as follows would be ample for all purposes and would, with proper supervision by competent instructors accomplish more in two years than the present system in some shops does in four. Bench work, 3 months; machines, 6 months; floor, 9 months; roundhouse, 3 months; special work, 3 months; total, 2 years.

Under special work would come dynamometer car, test work, drafting, etc. Some roads require boiler shop, but unless a man is to be employed there later as an assistant foreman, one month should suffice. Some roads require no work in the boiler shop at all.

One other thing—give them a fair living wage; some roads do, but the majority do not. The pay is usually from 15 cents to 20 cents an hour the first year and from 20 cents to 30 cents the last. The result is that two-thirds have to have additional funds from home.

Give a course of two years properly conducted, make the men earn their money and pay them what they earn; and make them work *after* their course is completed as well, increasing their pay accordingly, and the railroads will be in dollars and cents on one hand and build up a force of executives on the other that will stick and return a hundred fold what the company has spent on their education and preparation.

I. I. W.

Lead Storage Batteries.—On the continent of Europe the lead battery appears to have made quite a permanent position for itself in connection with a certain class of road transit. Complete fire brigade equipments, tower wagons and light postal vans are used in considerable numbers, while one company has produced and sold large numbers of powerful tractors for municipal service.—*The Engineer.*

High Speed Ship Propellers.—A new propeller for high speed ships has been patented by Sir Charles Parsons. It has blades of large area, with a leading edge of scimitar or thrown-back shape. The formation, which is verified by experiment, induces a more regular stream-line motion of the fluid round the blade, and has a considerably improved efficiency at high speeds, while showing some improvement at low speeds.—*The Practical Engineer.*

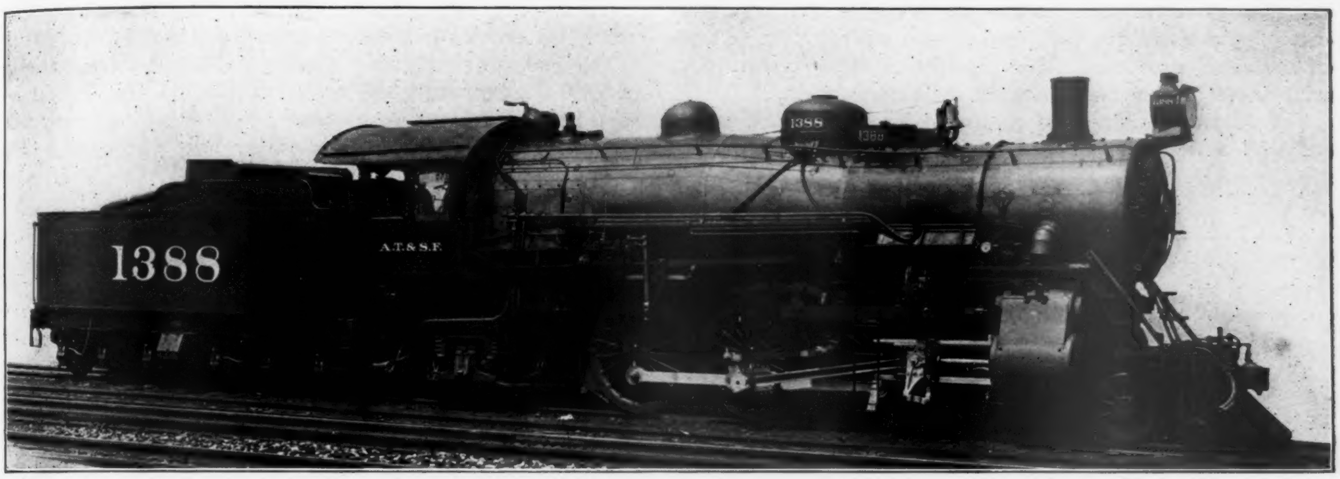
NEW LOCOMOTIVES FOR THE SANTA FE

Six Wheel Tender Trucks on Passenger Locomotives—Mikado Type Introduced on This Road

The Atchison, Topeka & Santa Fe has recently placed in service eighty-eight new locomotives, which were built by the Baldwin Locomotive Works. Five types are represented, as follows:

10 consolidations for oil burning.
12 Santa Fe type for coal burning.
32 Pacifics. These all have balanced compound cylinders. Thirteen burn oil, fifteen bituminous coal and four Gallup coal (a species of lignite).
29 Mikados for coal burning.
5 switchers for oil burning.

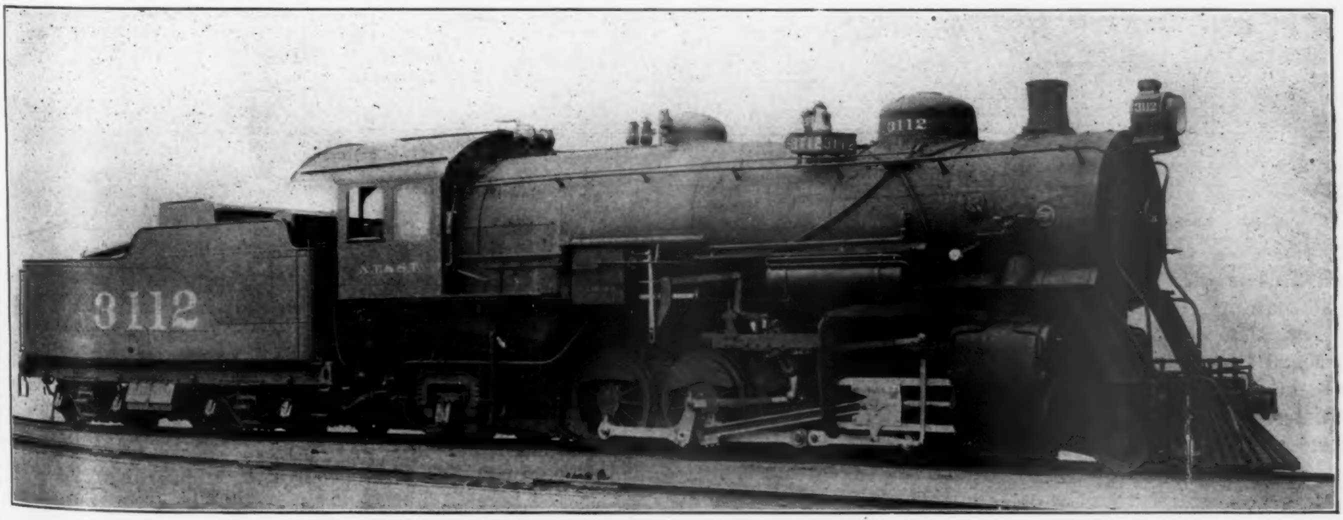
In designing these locomotives, special attention was given to making the details interchangeable with those on locomotives previously built; and practically all parts subject to wear interchange with engines of other classes. This is especially true in the case of the 2-10-2, or Santa Fe type locomotives. The two classes have the same piston stroke and driving-wheel diameter, and the driving-wheel centers, tires, boxes and axles are interchangeable; as are also the crank pins and piston valves, and, as far as possible, the valve gear details. The front foot plates and cast steel frame crossties also interchange on these two classes.



Pacific Type Locomotive with Six-Wheel Tender Trucks.

With the exception of the 2-8-2 type, which represent a new design on this road, these engines are all nearly duplicates of others previously built.* Special interest therefore centers in the mikados, which are intended for heavy freight service on divisions having moderate grades. These locomotives were designed with a weight limitation of 55,000 lbs. on each pair of driving wheels, and the actual weight runs close to this limit, with a very even distribution; the minimum and maximum weights per pair of wheels being respectively 54,500 lbs and 54,900 lbs. The tractive effort is 50,700 lbs., and the locomotives can traverse 16 deg. curves.

The boilers of the Mikado type locomotives, although somewhat smaller than those of the Santa Fes, are generally similar in construction. The grate castings are interchangeable, and the superheaters are alike except for the lengths of the pipes. The safety-valves on the Mikado type are mounted over a 16-in. manhole, located back of the main dome. The openings for the dome manhole are in the third boiler ring, which has a welded longitudinal seam on the top center line. The joint is strengthened by a large inside liner, cut from a single piece of



Mikado Type Locomotive on the Santa Fe.

*For description and dimensions see *American Engineer*, October, 1912, page 515.

11/16 in. plate. The dome is of pressed steel, in one piece. The furnace equipment includes a brick-arch, also power-operated fire door and grate shaker.

The cylinders have the same diameter as those of the latest single expansion Pacific type locomotive built for this road, and the cylinder heads of the two classes are interchangeable. The cylinders of the Mikados are provided with vacuum relief valves, and also with drifting valves of the Sheedy pattern. The main frames extend forward under the cylinder saddle, in the form of single rails which measure 5 in. in width and taper in depth from 12 in. at the front to 15 in. at the back. Nine horizontal and two vertical bolts, 1¼ in. in diameter, secure each cylinder casting to the corresponding frame. The cylinders are also bolted to the front deck-plate by six 1¼ in. bolts, and are secured to the smoke-box shell, and to each other, by double rows of the same size bolts. This provides a strong construction, with ample bearing areas between the various parts.

The steam distribution is controlled by 16-in. piston valves set with a lead of ¼ in. The gears are controlled by the Ragonnet reverse mechanism. This device has been applied to all road engines recently built for the Santa Fe.

As in the ten-coupled locomotives, these engines have supplemental counterweights keyed to the main axle between the frames. This has proved, on this road, a satisfactory method of counterweighting locomotives which have heavy reciprocating and revolving parts and comparatively small driving wheels.

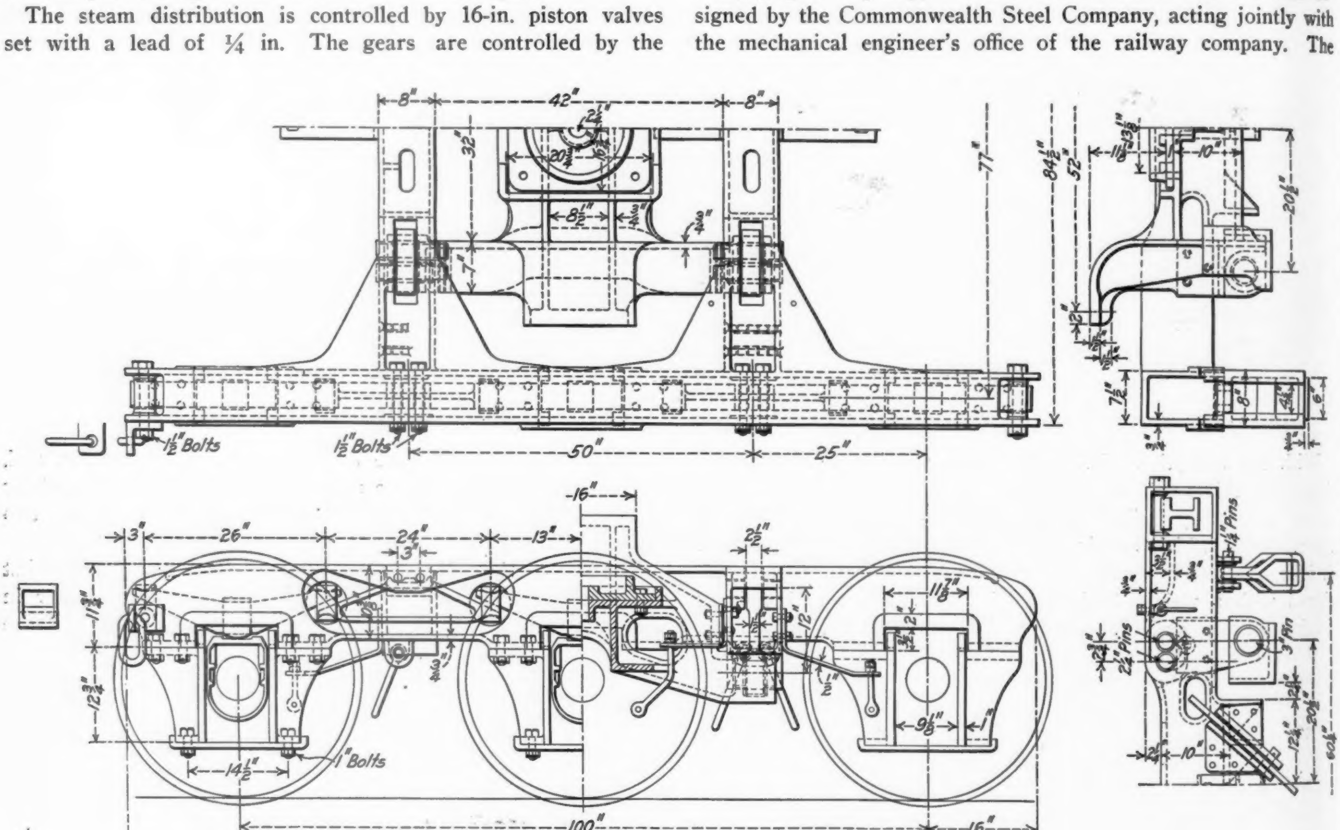
The arrangement of the rear frames and trailing truck in these engines is materially different from that used in the Santa Fe type locomotives. In the latter design, the firebox extends forward over the rear drivers, and the trailing truck carries 25,500 lbs. It is of the Rushton pattern, with inside journals which measure 7½ in. x 12 in. In the Mikado type locomotives, the firebox is placed back of the driving wheels, and the rear truck carries 40,700 lbs. It is also of the Rushton pattern, but with outside journals, measuring 8 in. x 14 in. With the exception of the springs, this truck is interchangeable with that used under the latest 2-6-6-2 type locomotives built for the Santa Fe. The springs interchange with those used on the single expansion Pacific type locomotives to which previous reference has been made.

The Mikado type locomotives have tenders of the railway company's standard design, with tanks of 8,500 gals. capacity. Twelve tons of coal can be carried, and a coal pusher is provided.

Including the new balanced compound locomotives, there are now in service, on the Santa Fe system, eighty balanced compound locomotives of the Pacific type with inclined high-pressure cylinders. The new locomotives represent the latest development of a type which has proved particularly successful, largely because of intelligent handling and the provision of suitable maintenance facilities. These locomotives are fully capable of working heavy express passenger traffic under the unusually difficult conditions existing on certain sections of this road.

The tenders of the new engines of this type have water tanks of 9,000 gals. capacity, and are carried on six-wheel trucks designed by the Commonwealth Steel Company, acting jointly with the mechanical engineer's office of the railway company. The truck wheel-base is 100 in. Each truck frame is of cast steel, in one piece, with pedestals of the same material bolted to it. The bolster is also of cast steel, and it is suspended on heart-shaped links which are pinned to the transverse sections of the truck frame. These links are unsymmetrical, the outside upper pin in each being vertically above the lower pin. As a result, one side of the bolster is raised higher than the other when the truck is displaced on a curve, thus helping to maintain the stability of the tender and keeping a more even distribution of weight on the inner and outer rails. The weight carried on each pair of wheels is approximately 30,000 lbs., which is moderate when compared to that found in many recent tenders of large capacity. The truck springs are of the half-elliptic pattern. They are mounted directly over the journal boxes, and the three springs on each side are connected by cast steel equalizers, which support the truck frame.

The problem of standardizing locomotive details is specially difficult on a system which, like the Santa Fe, includes both level



Six-Wheel Equalized Tender Truck with Cast Steel Frame.

and mountain divisions, and requires a variety of locomotive types for its successful operation. This problem, however, is being successfully solved; and the new Mikado type locomotives illustrate in a striking manner, how the work is being accomplished. The result will be a decrease in maintenance costs and in the amount of stock required for renewals, together with fewer engine failures and increased motive power efficiency.

The general dimensions, weights and ratios of the new 2-8-2 type locomotives are given in the following table:

General Data.

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive effort	50,700 lbs.
Weight in working order	284,100 lbs.
Weight on drivers	218,900 lbs.
Weight on leading truck	24,500 lbs.
Weight on trailing truck	40,700 lbs.
Weight of engine and tender in working order	455,000 lbs.
Wheel base, driving	16 ft.
Wheel base, total	34 ft. 1 in.
Wheel base, engine and tender	66 ft. ¼ in.

Ratios.

Weight on drivers ÷ tractive effort	4.32
Total weight ÷ tractive effort	5.60
Tractive effort × diam. drivers ÷ heating surface*	531.00
Heating surface* ÷ grate area	93.00
Firebox heating surface ÷ evaporating heating surface, per cent	6.38
Weight on drivers ÷ heating surface*	40.20
Total weight ÷ heating surface*	52.10
Volume both cylinders, cu. ft	18.30
Heating surface* ÷ vol. cylinders	297.00
Grate area ÷ vol. cylinders	3.19

Cylinders.

Kind	Simple
Diameter and stroke	25 in. x 32 in.

Valves.

Kind	Piston
Diameter	16 in.
Lead	¼ in.

Wheels.

Driving, diameter over tires	57 in.
Driving, thickness of tires	3½ in.
Driving journals, main, diameter and length	11 in. x 12 in.
Driving journals, others, diameter and length	10 in. x 12 in.
Engine truck wheels, diameter	29¼ in.
Engine truck, journals	6½ in. x 10½ in.
Trailing truck wheels, diameter	40 in.
Trailing truck, journals	8 in. x 14 in.

Boiler.

Style	W. T.
Working pressure	170 lbs.
Outside diameter of first ring	78¾ in.
Firebox, length and width	108 in. x 78 in.
Firebox plates, thickness	⅜ and 9/16 in.
Firebox, water space	F., 5 in.; S. & B., 4½ in.
Tubes, number and outside diameter	240—2¼ in.
Tubes, thickness	No. 11, B. W. G.
Flues, number and outside diameter	36—5½ in.
Flues, thickness	No. 9, B. W. G.
Tubes and flues, length	20 ft.
Heating surface, tubes	3,849 sq. ft.
Heating surface, firebox	237 sq. ft.
Heating surface, arch tubes	25 sq. ft.
Heating surface, total	4,111 sq. ft.
Superheater heating surface	880 sq. ft.
Grate area	58.5 sq. ft.

Tender.

Wheels, diameter	34¼ in.
Journals, diameter and length	5½ in. x 10 in.
Water capacity	8,500 gals.
Coal capacity	12 tons

*Equivalent heating surface equals evaporating surface (4,111 sq. ft.) plus 1.5 times superheating surface (880 sq. ft.), or 5,431 sq. ft.

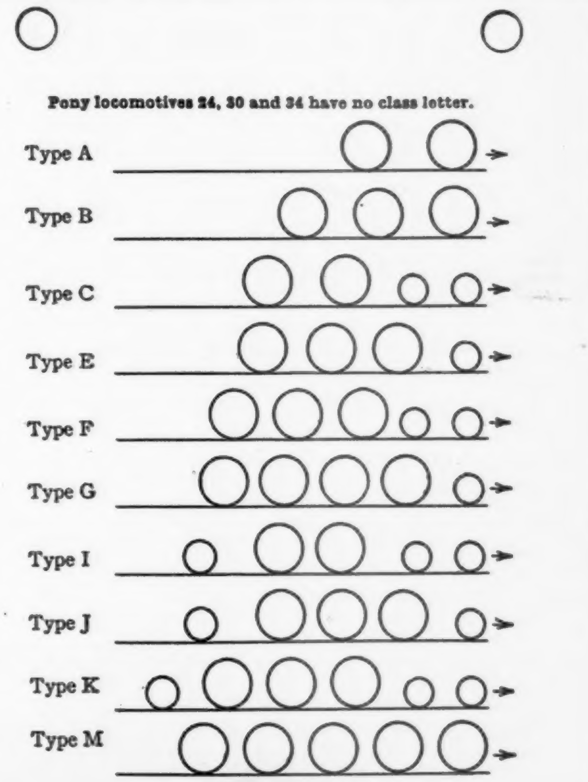
LIGHT BURNING ON PINE FORESTS.—The effect of light surface fires on pine timber is to kill or damage more than half of the mature trees, according to findings just announced by the United States forest service.

FOREST FIRES.—Forest officers throughout the West are congratulating themselves on a season so markedly free from heavy losses. They feel that the immunity from loss has been due to two principal causes, partly to a favorable season, but largely to a much better organization for fire prevention than has been attained heretofore. The effectiveness of the organization is shown particularly by the fact that while there were in all approximately 2,260 fires, as against 2,470 last year, yet the area burned so far this year is only about 60,000 acres as against 230,000 acres in 1912, and 780,000 in 1911.

CONDENSED RECORD OF LOCOMOTIVE EQUIPMENT

BY R. M. SWARTZ,
New York Central Lines, Chicago, Ill.

It is a general practice on most large railroads to maintain a record of the locomotive equipment in a condensed form, particularly for the use of those both in and out of the motive power department who do not have ready access to the drawings and other records covering the locomotive data, but who must have the information as to the tractive effort, general dimensions and the number of each class and type, etc., of locomotives. To be of the greatest value this record should be of a size that may



EXPLANATION.

In the designation of classes the first letter, the index letter, a one-inch letter as placed on cabs, indicates the wheel arrangement as given above. All locomotives with the same wheel arrangement have the same letter beginning the class designation. Difference in design, size, etc., of locomotives with same wheel arrangement is indicated by the number following the dash. A small letter following a class letter or figure indicates that the locomotives are slightly different from those in the class represented by the letters and numbers preceding the small letters. Thus in the class designation "F-48c" the "F" indicates a ten-wheel locomotive, the "48" indicates a particular design of the ten-wheel locomotive, and the "c" (half the size of the "F" and "48") indicates that the locomotives in this class are slightly different from locomotives in the class "F-48B." Similarly locomotives in class "F-48B" are slightly different from class "F-48A," although all three classes are alike in general.

Fig. 1—Classification Sheet.

be conveniently carried in a pocket, and it should be kept as nearly up-to-date as possible. One practice is to issue blueprinted books or to print the books and bind them in permanent binders. With the former method the books are either too large to be conveniently carried in a pocket, or, if of pocket size, are more or less incomplete and are not accompanied by a diagram of the engine, on account of the difficulty of preparing the text and diagrams of this small size which will make satisfactory blueprints. The latter method is satisfactory when the books are first printed, but they rapidly get out of date, necessitating reprinting at two or three year intervals.

To overcome the objections to both these types of books, the Lake Shore & Michigan Southern recently issued a book in a loose leaf form which can be maintained indefinitely without reprinting the entire book, by simply adding new sheets for new power purchased or reprinting individual sheets when the number of corrections on a sheet makes it advisable to do so. The book is made up of four essential parts:

First: A "basis of typification" sheet based on the Whyte system of locomotive classification, as used on the New York Central Lines, showing the general class letter assigned to each type of locomotive according to wheel arrangement. (See Fig. 1.)

No.	Class	Owner-ship	No.	Class	Owner-ship	No.	Class	Owner-ship	No.	Class	Owner-ship
5538	G-44	L	5577	G-46D	...	5616	G-6M	...	5655	G-6B	...
5539	G-44	L	5578	G-46D	...	5617	G-6M	...	5656	G-6B	...
5540	....	...	5579	G-46D	...	5618	G-6M	...	5657	G-6B	...
5541	....	...	5580	G-46D	...	5619	G-6M	...	5658	G-6B	...
5542	....	...	5581	G-46D	...	5620	G-6M	...	5659	G-6B	...
5543	....	...	5582	G-46D	...	5621	G-6M	...	5660	G-6B	...
5544	....	...	5583	G-46D	...	5622	G-6M	...	5661	G-6B	...
5545	....	...	5584	G-46D	...	5623	G-6M	...	5662	G-6B	...
5546	....	...	5585	G-46D	...	5624	G-6M	...	5663	G-6B	...
5547	....	...	5586	G-46D	...	5625	G-6M	...	5664	G-6B	...
5548	....	...	5587	G-46D	...	5626	G-6M	...	5665	G-6B	...
5549	....	...	5588	G-46D	...	5627	G-6M	...	5666	G-6B	...
5550	....	...	5589	G-46D	...	5628	G-6M	...	5667	G-6B	...

Fig. 2—General Numerical List.

Second: A general list of engine numbers, which also shows the class designation of each particular engine and the initial of the owning road, when the engine is the property of a subsidiary line. (See Fig. 2.)

Class.	Type.	No. of Loco's	Hauling Cap'y Percentage	Cylinder	Diam. of Driving Wheel	Boiler Pressure	Weight on Drivers, Lbs.	Service.
G-5ACDE	Consol.	38	47.0	23 x32	63	200	200000	Freight
G-5KMYZ	"	65	47.2	23 x32	63	200	207000	"
G-5R	"	25	47.2	23 x32	63	200	208000	"
G-6B	"	20	47.2	23 x32	63	200	211000	"
G-6M	"	40	47.2	23 x32	63	200	214500	"
G-6V	"	15	47.2	23 x32	63	200	211500	"
G-16V	"	10	50.2	25 x32	63	180	214500	"
G-42A	"	25	35.1	21 x30	63	200	149000	"
G-42B	"	24	36.2	21 x30	63	200	154000	"
G-43	"	120	36.8	21 x30	63	200	158000	"
G-46AB	"	7	49.1	23 x30	57	200	203000	"
G-46D	"	20	49.1	23 x30	57	200	211000	"
G-46G	"	15	49.1	23 x30	57	200	214500	"
I-40	Atlantic	10	21.4	19 x26	69	180	97500	Passenger
J-40	Prairie	46	25.3	20½x28	81	200	134000	"
J-41A	"	9	28.6	21½x28	79	200	168000	"
J-41B	"	1	28.6	21½x28	79	200	168800	"
J-41C	"	10	28.6	21½x28	79	200	170000	"
J-41D	"	7	28.6	21½x28	79	200	165200	"
K-2ADL	Pacific	90	29.9	22 x28	79	200	170700	"
K-2BC	"	5	29.9	22 x28	79	200	167000	"
K-3	"	10	31.7	23½x26	79	200	173000	"
M-1	10 Wh. Switch	8	62.5	25½x28	52	210	270000	Switching

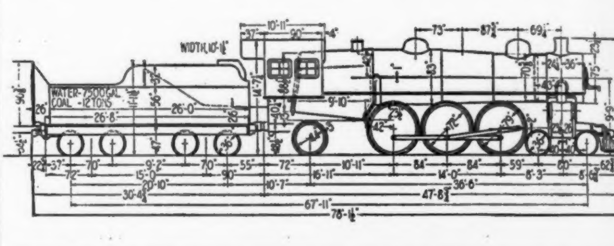
Fig. 3—Condensed Classification.

Third: A condensed classification, which covers the number of engines in each class, the type and the service, with the tractive effort, the diameter and the stroke of the cylinders, diameter of the driving wheels and the weight on drivers of each class. (See Fig. 3.)

Fourth: Individual classification sheets for each class of engine, each sheet having a small but complete diagram of the engine with its principal dimensions, a statement of the important data pertaining to the class and a list of the individual engine numbers. Each number is followed by arbitrary letters indicating the special equipment, such as superheaters, pneumatic fire doors, etc., on the engine. (See Fig. 4.)

The parts of the book are usually assembled in the order given, but on account of its flexible character, the holder may rearrange the different portions in the most convenient manner for his own particular use. While the book was in preparation superheaters were being applied to a number of classes of the larger power. As it was the intention to eventually equip all of the engines of such classes it was not deemed advisable to change the sub-classification letter. In such cases the individual

Builder's Order No. S-781. **Class K-3B**
No. of Locos. 10.
Built by American Loco. Co., Schenectady, 1911.



Kind of main valve............Piston 14 in.	Heating surface total..........3791.3 sq. ft.
Valve travel.........................7 in.	*Heating surface superheater.....1086 sq. ft.
Kind of valve gear..............Walschaert	Heating surface grand total.....4877.3 sq. ft.
Firebox length inside..........108 1-8 in.	Weight on drivers working order 173,000 lbs.
Firebox width inside...........75 1-4 in.	Weight on front truck............50,000 lbs.
Grate area.......................56.4 sq. ft.	Weight on back truck............48,000 lbs.
Tubes, large....................28 5 3-8 in.	Weight total of engine..........271,000 lbs.
Tubes, small.....................242 2 in.	Weight of tender loaded.........155,300 lbs.
Tubes length over sheets........21 ft. 6 in.	Weight of tender empty...........69,000 lbs.
Heating surface tubes...........3560 sq. ft.	Steam pressure.....................200 lbs.
Heating surface firebox, including arch flues........231.3 sq. ft.	Rating..........................31.7 per cent

Engine No.	Special Equip.	Engine No.	Special Equip.	Engine No.	Special Equip.	Engine No.	Special Equip.
4895	HASF	....	....	....	....	....	....
4896	HASF	....	....	....	....	....	....
4897	HASF	....	....	....	....	....	....
4898	HASF	....	....	....	....	....	....
4899	HASF	....	....	....	....	....	....
4900	HASF	....	....	....	....	....	....
4901	HASF	....	....	....	....	....	....
4902	HASF	....	....	....	....	....	....
4903	HASF	....	....	....	....	....	....
4904	HASF	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....

H—Steambeat K—Stoker *Superheater surface as given is 1½ times
A—Air Signal F—Franklin Door actual surface of superheater elements.
S—Superheater E—Fire Extinguisher

Class K-3B

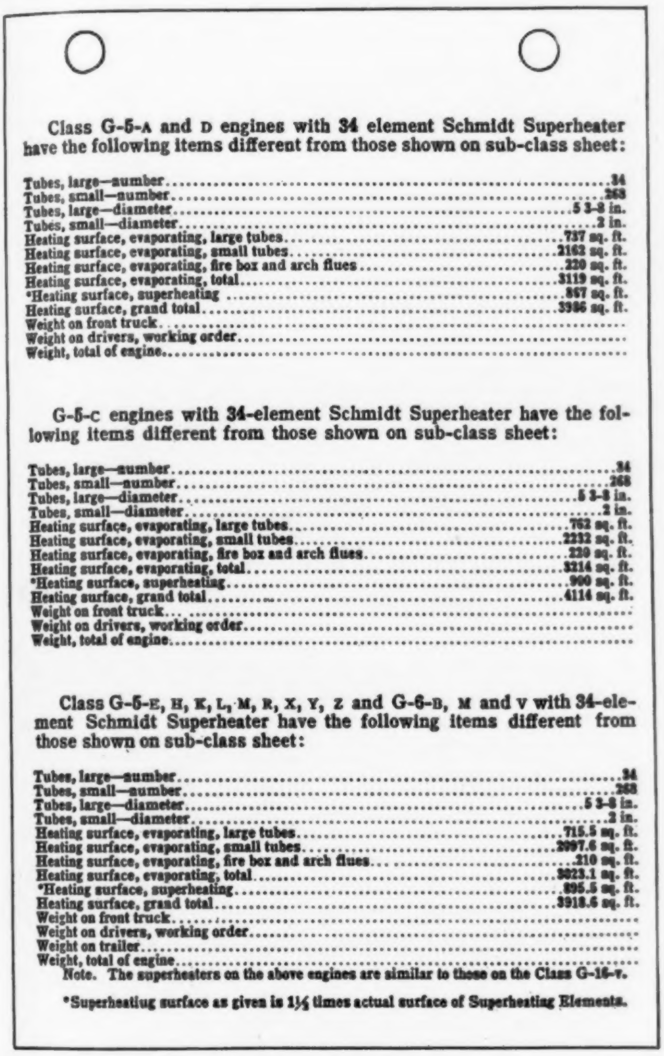
Fig. 4—Individual Classification Sheet.

sub-class sheet was made out to carry the data for the engines when using saturated steam, and appendix sheets added at the back of the book to show the number of tubes, heating surface, weights, etc., after the application of superheaters, reference being made to the proper appendix sheets on the bottom of the individual classification sheet. (See Fig. 5.)

Loose leaf holders 4¼ in. x 6¾ in. in size are used, it being a simple matter to remove or replace sheets by removing the binding screws. Minor corrections are made to the sheets without removing them from the covers.

Lists of corrections are sent out to all holders of books at frequent intervals from the office of the superintendent of motive power, new sheets being printed and sent out with the lists of corrections in the case of new power or when a sheet is reprinted on account of a large number of corrections making it advisable to do so.

The initial expense of preparing a book along these lines is somewhat greater than for printing a book using permanent binding, or for issuing in blueprint form, but the fact that once



Class G-5-A and D engines with 34 element Schmidt Superheater have the following items different from those shown on sub-class sheet:

Tubes, large—number	34
Tubes, small—number	268
Tubes, large—diameter	5 3-8 in.
Tubes, small—diameter	2 in.
Heating surface, evaporating, large tubes	737 sq. ft.
Heating surface, evaporating, small tubes	2162 sq. ft.
Heating surface, evaporating, fire box and arch flues	220 sq. ft.
Heating surface, evaporating, total	3119 sq. ft.
*Heating surface, superheating	867 sq. ft.
Heating surface, grand total	3986 sq. ft.
Weight on front truck	
Weight on drivers, working order	
Weight, total of engine	

G-5-C engines with 34-element Schmidt Superheater have the following items different from those shown on sub-class sheet:

Tubes, large—number	34
Tubes, small—number	268
Tubes, large—diameter	5 3-8 in.
Tubes, small—diameter	2 in.
Heating surface, evaporating, large tubes	762 sq. ft.
Heating surface, evaporating, small tubes	2232 sq. ft.
Heating surface, evaporating, fire box and arch flues	220 sq. ft.
Heating surface, evaporating, total	3214 sq. ft.
*Heating surface, superheating	900 sq. ft.
Heating surface, grand total	4114 sq. ft.
Weight on front truck	
Weight on drivers, working order	
Weight, total of engine	

Class G-5-E, H, K, L, M, R, X, Y, Z and G-6-B, M and V with 34-element Schmidt Superheater have the following items different from those shown on sub-class sheet:

Tubes, large—number	34
Tubes, small—number	268
Tubes, large—diameter	5 3-8 in.
Tubes, small—diameter	2 in.
Heating surface, evaporating, large tubes	715.5 sq. ft.
Heating surface, evaporating, small tubes	2097.6 sq. ft.
Heating surface, evaporating, fire box and arch flues	210 sq. ft.
Heating surface, evaporating, total	3023.1 sq. ft.
*Heating surface, superheating	895.5 sq. ft.
Heating surface, grand total	3918.6 sq. ft.
Weight on front truck	
Weight on drivers, working order	
Weight on trailer	
Weight, total of engine	

Note. The superheaters on the above engines are similar to those on the Class G-16-V.

*Superheating surface as given is 1⅕ times actual surface of Superheating Elements.

Fig. 5—Sub-Class Sheets.

printed the life of the book may be indefinitely extended and the ease and small expense with which books are kept up-to-date more than compensate for the somewhat greater first cost.

AN ATLANTIC TYPE LOCOMOTIVE AND A HEAVY TRAIN

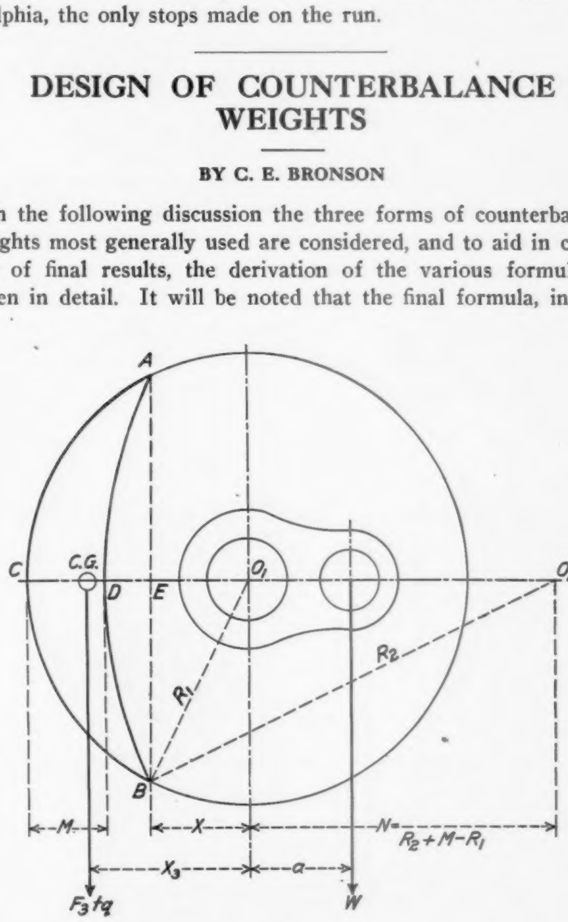
A thirteen car train weighing 984 tons on a schedule which requires a sustained speed of practically 60 miles an hour, would be far beyond the capacity of the usual Atlantic type locomotive. Such performance, however, was recently made by a 4-4-2 type locomotive on the New York division of the Pennsylvania Railroad. This locomotive is one of a group known as class E-6-s, which are the largest of this type in service. The train in this case consisted of ten steel Pullman sleeping cars, one 70-ft. steel passenger coach, one 70-ft. steel combination passenger and baggage car and a 70-ft. steel postal car. The total weight of the train was 984 tons. The locomotive received the train at Manhattan Transfer, N. J., and left at 8:48 p. m. It left Newark three minutes late on account of a very long stop and, due to a speed limit through Rahway, passed Perth Amboy Junction 4½ min. late. From this point to Metuchen, a distance of 5.8 miles an average speed of 46½ miles per hour was made, the run requiring 7½ min., which, considering the slow movement through Rahway, was exceptionally good. The run from New Brunswick to Frankford Junction, a distance of 49.1 miles was made in 50½ min., or an average speed of 58.5 miles per hour. Seven minutes were lost from this point to North Philadelphia, due to signals on account of a train ahead and the train was taken into Broad street six minutes late, but would have gone in on time had it not been for this delay from Frankford Junction. When it is considered that there is a speed limit of 70 miles per hour on this division it will be seen that this engine made a remarkable record for sustained speed.

The first locomotive of this type, which was not fitted with a superheater, was fully illustrated and described on page 124 of the April, 1911, issue of the *American Engineer and Railroad Journal*. The superheater locomotive is slightly larger than the original engine and has a total weight of 237,000 lbs., of which 139,500 lbs. is on drivers. The drivers are 80 in. in diameter and the cylinders are 23 in. x 26 in. The boiler pressure is 205 lbs. The evaporative heating surface in the boiler is 2,433.2 sq. ft. and the firebox heating surface is 218 sq. ft., giving a total of 2,651.2 sq. ft. The superheater of the fire tube type has a heating surface of 653 sq. ft. The locomotive had no difficulty in starting the train at Manhattan Transfer, Newark or North Philadelphia, the only stops made on the run.

DESIGN OF COUNTERBALANCE WEIGHTS

BY C. E. BRONSON

In the following discussion the three forms of counterbalance weights most generally used are considered, and to aid in checking of final results, the derivation of the various formulas is given in detail. It will be noted that the final formula, in each



case, entirely eliminates the necessity for finding the center of gravity of the counterbalance block.

CRESCENT SHAPED COUNTERBALANCE.

Let F_1 = Area of the segment ABC.

x_1 = Distance of the center of gravity of the segment ABC from O_1.

F_2 = Area of the segment ABD.

x_2 = Distance of the center of gravity of the segment ABD from O_1.

F_3 = Area of the crescent ACBD.

x_3 = Distance of the center of gravity of the crescent ACBD from O_1.

t = Thickness of the counterbalance weight in inches.

q = Weight per cubic inch of the material in the counterbalance weight.

W = Weight to be counterbalanced at the crank pin radius a.

Using the formula for center of gravity of a segment from Church's Mechanics, page 23, the values for x_1 and x_2 are

$$x_1 = \frac{(AB)^3}{12F_1} \text{ and } x_2 = \frac{(AB)^3}{12F_2} - N$$

$$F_3 x_3 = F_1 x_1 - F_2 x_2$$

Substituting the values for x_1 and x_2 in the last equation,

$$F_3 x_3 = F_1 \left[\frac{(AB)^3}{12F_1}\right] - F_2 \left[\frac{(AB)^3}{12F_2} - N\right]$$

$$F_3 x_3 = NF_2$$

For equilibrium of forces in this case

$$F_3\ tq x_3 = Wa \quad \text{or} \quad F_3 x_3 = \frac{Wa}{tq}$$

Combining the two equations and solving for t we find

$$t = \frac{Wa}{qNF_2}$$

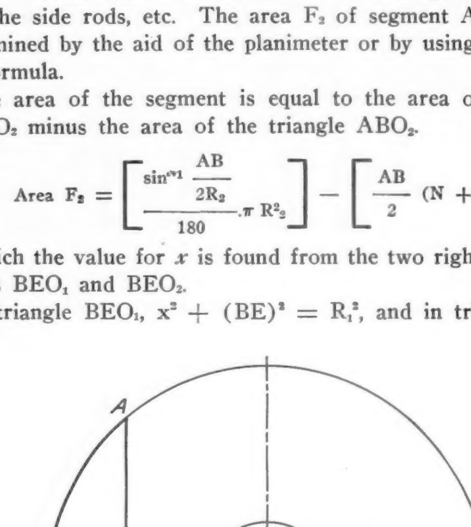
In using this formula, it will be found more convenient to assign values for M and R_2, increasing the value of M if the thickness of counterbalance is found to be too large for clearance past the side rods, etc. The area F_2 of segment ABD may be determined by the aid of the planimeter or by using the following formula.

The area of the segment is equal to the area of the sector $ADBO_2$ minus the area of the triangle ABO_2.

$$\text{Area } F_2 = \left[\frac{\sin^{-1} \frac{AB}{2R_2}}{180} . \pi R_2^2\right] - \left[\frac{AB}{2} (N + x)\right]$$

in which the value for x is found from the two right-angled triangles BEO_1 and BEO_2.

In triangle BEO_1, $x^2 + (BE)^2 = R_1^2$, and in triangle BEO_2



$(x + N)^2 + (BE)^2 = R_2^2$. Solving both equations for $(BE)^2$ and combining:

$$x = \frac{R_2^2 - R_1^2 - N^2}{2N}$$

SEGMENT COUNTERBALANCE.

Using the same notation, as above

$$x = \frac{(AB)^3}{12F}$$

For equilibrium of forces.

Solving for x

$$Ftqx = Wa$$

$$x = \frac{Wa}{Ftq}$$

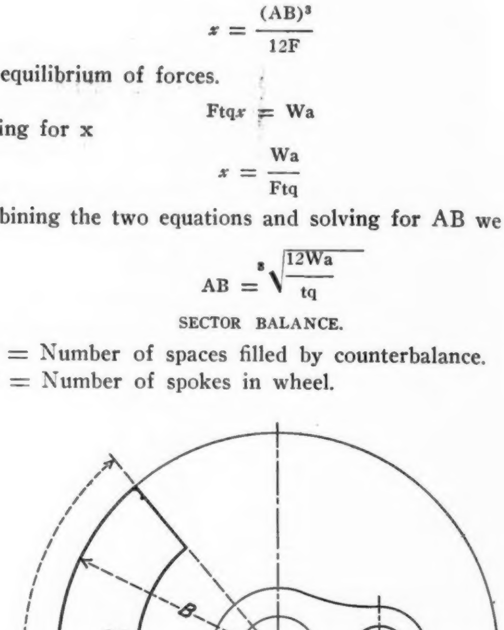
Combining the two equations and solving for AB we find

$$AB = \sqrt[3]{\frac{12Wa}{tq}}$$

SECTOR BALANCE.

Let M = Number of spaces filled by counterbalance.

N = Number of spokes in wheel.



For equilibrium of forces in this case

$$Wa = Ftqx$$

Substituting in this equation the value of x for a sector of a flat ring from Church's Mechanics, page 22, we have:

$$Wa = Ftq . \frac{4}{3} . \frac{B^3 - A^3}{B^2 - A^2} . \frac{\sin \frac{1}{2} K}{K}$$

The area F may be expressed as follows:

$$F = \frac{K}{360} (\pi B^2 - \pi A^2) = \frac{\pi M}{N} (B^2 - A^2)$$

Substituting this value we have:

$$Wa = \frac{\pi M}{N} (B^2 - A^2)\ tq . \frac{4}{3} . \frac{B^3 - A^3}{B^2 - A^2} . \frac{\sin \frac{180 M}{N}}{\frac{2\pi M}{N}}$$

Reducing and solving for A

$$A = \sqrt[3]{B^3 - \frac{3Wa}{2tq . \sin \frac{180 M}{N}}}$$

Metal Plating by Deposition.—A new process of electrodeposition is claimed to have effected a very substantial advance that may have a more than ordinary effect on various branches of industry. In the manufacture of tin plate it is said to be possible to coat effectively 112 plates, 14 in. x 22 in., with 1 lb. of tin, as against 1¾ lbs. by hot dipping. It is also claimed that no wasters are made, there are no fumes injurious to health, and that boy labor may be employed. In galvanizing the cost of coating is said to be one-half that of hot dipping.—*The Practical Engineer.*

EFFICIENT POWER PLANT OPERATION

Large Losses Result from Machinery in Need of Repair and Pipe Lines Improperly Maintained

BY ERNEST CORDEAL.

Inefficiencies that will increase the unit cost to many times the ideal figure, may easily creep into the production of heat, light and power for the operation of a shop or factory. This applies more particularly perhaps to the power plants in connection with railroad shops and engine houses than to factories.

As an example, the power plant at a small railroad terminal, through years of service and as many years of neglect, had reached a point of inefficiency where the average cost per month of furnishing heat, light and power was $908. At last a point was reached where no increase in cost of operation served to produce from the plant the amount of power actually required,. and an investigation was made to determine what action was necessary. Under competent council the various power units were overhauled at small expense; pipe lines were gone over and the leaks stopped, steam lines were protected from the condensing effect of cold weather, an adequate system of checking fuel consumption was installed and the firemen and engineers were instructed in the proper methods of firing. The total cost of all repairs and improvements was less than $250. The cost of operation decreased during the next six months period to an average of $420 per month.

The peculiar conditions of railroad shop work render close supervision of power production essential to reasonable cost of operation. The shop power plant must furnish steam for heating buildings and for draft in firing up; air for operating motors, hoists and jacks and for testing air equipment; electricity for lighting and for operating electric tools and motors, often in addition to its regular function of furnishing power for the operation of engine driven shafting. The load to be carried is, under the best conditions, variable through a very wide range and the plant designed or re-inforced to meet the maximum requirements must operate at a comparatively low efficiency during a greater part of the time in order to provide for emergencies. Perhaps the knowledge that a certain amount of inefficiency in power plants is inevitable is responsible for the fact that in very few cases is any attention given to the cost per unit, or any effort made to effect economy in this department. That economies, which are very large when the importance of the power item in relation to the total cost of operation is considered, may be effected by careful study and systematic supervision, has been often proved by the results following serious efforts along this line.

Probably the principal difficulty encountered in any endeavor to investigate power plant efficiency will be the entire absence, in nearly all cases, of any means of determining the amount of power of the various classes which is being actually generated or consumed. Companies which generate gas, electricity or steam for sale to individual concerns, find it expedient to install meters, even when the consumption through certain of these gages does not amount to a value of one dollar a month. Such companies must know exactly how much it is costing them to produce the product which they sell, in order that equitable prices may be set which will allow them a profit on their investment, and enable them to compete with other companies producing the same or substitute commodities. It may be argued that a concern which is generating power for its own use only need not go to the expense of installing meters, as the entire cost of operating the power plant must be carried in the overhead charges and that information as to amounts used and unit costs are superfluous. If the same plant purchased its power from an outside company the manager would object strongly to paying for it at the rate of maximum consumption and would probably insist on some method being employed whereby he would only be charged with the amount of power which was actually used.

A little thought will be sufficient to show that the two cases are analogous. The product of the plant must pay for the power regardless of whether it is furnished by an outside concern at so much a unit, or is generated at the plant itself and its cost is carried as an item of expense of operation. It is, therefore, just as important that means should be provided for measuring the amounts used and figuring the cost in one case as in the other. Meters are not absolutely essential to efficient power generation, but their use is the only means of providing definite knowledge that the maximum economy in power unit cost has been effected, and what the unit cost is as compared with other plants, or with power purchased from independent companies.

Regardless, however, of whether or not meters are provided, there are a number of items contributing to inefficient power plant operation which may be controlled by careful supervision. These items are in a greater or less degree common to nearly all power stations, particularly those in connection with railroad shops. For convenience they may be classified under the five following heads: Inefficient power units; leaks in air and steam lines; waste of delivered power; waste of fuel at boilers, and waste of labor.

INEFFICIENT POWER UNITS.

The proper designing of power units to insure the maximum economy is not strictly a matter of operation, and it is not intended that this article should deal with that phase of the question. The problem of the engineer in charge of a power station is to so operate the equipment with which he is provided as to insure the maximum efficiency under existing conditions. An engine, compressor or dynamo may be of such a design as to permit of only 50 per cent. efficiency, as compared with the best obtainable article in that line, but if the engineer in charge succeeds in obtaining the 50 per cent. result from the machine, his effort has been 100 per cent. efficient. On the other hand, if the unit only operates at an efficiency of 25 per cent., the engineer's effort has only been of 50 per cent. quality. His efforts should therefore be directed toward obtaining from the equipment provided, the maximum possible economy. This can only be done by keeping all machinery in the best of repair.

The engine which pounds, runs hot or drags is consuming more steam than it should and the cost of the power it produces is consequently higher than it should be. Neglected small repair items, although they may not materially affect the cost of output, lead to heavy repair charges at a subsequent time, all of which expense must be figured in the final cost of the power delivered. It is not an uncommon sight to see a compressor working at unnecessarily high speed and with high steam consumption in an endeavor to keep up the air pressure against a handicap of leaking valves and packing, whereby only a fraction of the work it performs is transmitted into usable power. Such conditions as these are inexcusable, but none the less common, and their existence may be traced directly to the absence of any comprehensive check on the cost of power. The importance of the inefficiency of power units does not end simply in the increased cost of power, but its effect may be traced through the entire shop wherever its product is used. The compressor, which, through lack of attention, is unable to keep up the required air pressure at all times, contributes to the inefficiency of every air tool in the shop, and the tool in turn retards the effectiveness of the effort put forth by the workmen in its operation.

Such a condition as this actually existing in a certain shop was responsible for a decrease of approximately one-half in the output of every man operating air tools. In the case of one particular man it was found that with the insufficient air pressure furnished he was only able to ream holes 1 in. to 1¼ in. in diameter and of an aggregate depth of 180 in. in 10 hours. The compressor and pipe lines were completely overhauled, after which the same man with the same motor and the same reamers averaged 350 in. in a 10 hour day.

Considering labor costs only and taking the workman's rate as 30 cents an hour, we find that while, with inadequate air pressure, it cost $5.83 to do 350 in. of reaming, the same work only cost $3 when the pressure was maintained. This represents a clear saving of $2.83 on the amount of work specified. Now, as there were approximately 20 men in this shop continually using air tools, it is safe to assume that the total loss for which the air compressor was responsible aggregated $56.60 a day, an item well worth consideration.

From this example it will be seen how inefficiency in the power plant not only increases the cost of power but also materially increases the labor cost of the shop output and decreases the effectiveness of the shop tool equipment.

Finding an opportunity to take power units out of service long enough to make necessary repairs is, perhaps, the cause of the difficulty in many instances. Machines are often under load for 24 hours a day, every day in the week, and no auxiliary equipment is provided to relieve them for a period sufficient for their thorough overhauling. The case is rare, however, where, by carefully planning ahead, arrangements cannot be made to give the necessary time required for repairs. Even the shutting down of the entire plant for a short period, although the apparent loss may be great, may prove in the end a measure of economy.

LEAKS IN AIR AND STEAM LINES.

One of the most prolific sources of high power costs is found in the loss of generated power without the production of any useful work. The long lines of air and steam pipes which convey power or heat from the power station to the various departments often waste far more through leakage, condensation and friction, than they deliver for effective use. The arrangement of pipe lines to provide protection from the weather, accessibility for inspection and repairs, and minimum distance of transmission should be given careful consideration, and when the best possible arrangement has been effected, frequent inspection should be made to detect any leakage or stoppage in the pipes which may cause waste. The engine house and repair yard are probably the worst offenders in the matter of pipe lines, as it is necessary to have many lines for conveying water, steam and compressed air, which must be placed in positions where they are liable to become cracked and broken. These conditions require that, not only should a careful study be given to their proper placing and protection, but that rigid and frequent inspection should be made to insure the prompt repair of any defects.

As an aid to the thorough inspection of pipe lines a map of the entire plant should be carefully prepared showing the exact location of all lines, length of sections and position of joints and elbows. This should be carefully revised whenever new lines are laid or changes made. It should be framed to prevent destruction or defacement and should occupy a conspicuous position in the power plant so as to be easily available for reference at all times.

An inspection trip around almost any plant will demonstrate the necessity of careful attention to pipe lines. The innumerable small leaks that will be found may account for a loss of generated power running as high as 50 per cent. of the total, or, in other words, equaling the total power effectively used. During the winter season, of course, the greater pipe line losses will be encountered, as at that time the loss through condensation becomes much greater, particularly in lines placed above the ground and not properly protected from the cold.

As an example of what fuel losses may be expected from exposed steam pipes the following actual case is cited: A 4 in. overhead pipe line 100 ft. long carrying steam at 100 lbs. pressure from the power plant to supply the steam hammers in the blacksmith shop, was entirely without protection. The heat radiated from this line in winter weather, when the temperature averaged 32 deg. F., amounted to a condensation of approximately 98 lbs. of water an hour. Using the ratio of 1 lb. of coal to 6 lbs. of water, the heat loss from this cause alone represented a little over 16 lbs. of coal an hour. Any good pipe covering would have reduced this loss by 90 per cent.

Sixteen pounds of coal does not represent a very large investment, but when it is considered that this loss is continuous and that proportional losses are sustained from each foot of uncovered pipe, also the cost of labor to handle the additional fuel, the cost of additional equipment and its upkeep and the effect of overload on the efficiency of the plant as a whole, it will be easily understood that this is an item which should not be overlooked.

In cold weather also the power plant carries the greatest load, as the heating of buildings is added to the power demands, and for that reason particular attention should be given to the protection of pipes from the effect of radiation. The leaks which develop are more easily detected in winter than in summer, but their correction is a far more difficult matter, and for these reasons a thorough overhauling of all pipe lines should take place before the beginning of cold weather. In any plant where a considerable length of pipe line is necessary it will be found a measure of economy to employ a regular pipe man on the staff of the power plant engineer, whose duty it should be to make a daily inspection of all lines, together with the connections and hose used by mechanics or others in applying power to their tools or machines, and to repair such small defects as would otherwise probably go unnoticed. Such a man taking proper interest in his work will be able to save many times the amount of his wages.

WASTE OF DELIVERED POWER.

By no means does all the loss of power lie between the power plant and the point of delivery. As insufficient power supply decreases the efficiency of otherwise effective tools, so do defective or unskillfully handled tools decrease the efficiency of the power furnished. A dull drill or an improperly ground reamer will waste more power than it actually uses in effective work; a motor or a machine in poor repair requires more power for the same amount of work than the same machine in good repair; shafting which runs when none of the machines which it drives are in operation, represents wasted power. Such wastes as these are not properly under the control of the power plant engineer but he may nevertheless obtain considerable economies by securing the co-operation of department foremen in reducing them to a minimum.

Poor tools are an expensive luxury, not so much from the point of power consumption, which in reality is a comparatively small item, as in their effect on the efficiency, both qualitative and quantitative, of the work performed, and the power plant man should encounter no difficulty in obtaining the aid of shop foremen and managers in correcting defects which are overloading his plant and holding back the output of the shop. The engineer may not be an expert on machine tools, in fact seldom will his knowledge of such matters permit him to offer comments or suggestions as to their proper design or operation, but he should be in a position to know whether or not such machines are wasteful in their consumption of power and his reports on this subject should be given the attention they deserve by the man responsible for results.

WASTE OF FUEL AT BOILER.

A surprisingly small proportion of the heat units contained in the fuel fed to stationary boilers ever develop any useful energy. A part of this loss is inevitable, but in the average plant much of it may be eliminated by careful supervision supported by a competent check of the fuel used in proportion to the steam generated. The design of the plant is an important feature in the fuel efficiency which may be obtained, but the plant equipped with modern equipment for securing the maximum fuel economy, or the antiquated equipment with none of these improvements, both lend themselves readily to the effect of wasteful managment. Some means of measuring the amount of steam generated by the boilers of a plant is an incalculable aid in checking up the efficiency of fuel performance, but this is a convenience which is seldom provided. The absence of such a check, however, is no valid reason for not securing a high standard of performance in the item of fuel consumption.

The fuel performance of a locomotive is quite generally computed on the basis of the tons hauled one mile and there is no reason why the load to be carried by power plants at various periods, or by various stations, may not be estimated with sufficient accuracy to provide a basis on which their efficiency may be computed. In locomotive practice it has been demonstrated that all the modern appliances such as superheaters, compound cylinders, stokers and brick arches, applied in an endeavor to decrease fuel consumption, are of little value unless their use is accompanied by intelligent action on the part of the crew in charge. In stationary practice as well, ignorance or carelessness on the part of engineers and firemen may lead to greater fuel losses than can be accounted for by the absence of modern equipment. Records of the fuel consumption and the load carried should be accurately kept and comparisons should be made to determine the relative efficiency of fuel consumption as between various plants and various periods at the same plant.

Firemen should be carefully instructed in the best methods of firing and the supervision should be such as to provide against lapses from the prescribed practice. The most efficient method of firing is a question which cannot be determined by any fixed law covering all conditions. The fuel itself, the design of boiler, the draft conditions and many other things must govern the practice which will be followed at any particular plant, and the practice that will prove to be the best can only be determined by intelligent trial. The quality of fuel that will produce the greatest amount of steam at the minimum cost is also a matter which must be determined individually for each plant. A cheap grade of slack or pea coal fired on grates designed for run of mine, will generally prove far more expensive in the end than higher priced coal of good quality; conversely, high grade coal fired in boilers designed to burn slack will prove expensive and troublesome.

Another point which has a direct bearing on the efficiency of the fuel performance and which will yield gratifying results, if given the proper attention, is the controlling of the number of boilers in use at times when the load is below the maximum. When two boilers are fired to do the work which could easily be handled by one, the waste of fuel is large and it will be found a measure of great economy to keep such a check on the power requirements at different periods of the day as will enable the boilers in use to be worked as nearly as possible to their full capacity.

WASTE OF LABOR.

Wasted labor in the power plant is, as a rule, associated with the handling of fuel and the disposal of cinders. Improper firing, which causes more coal to be thrown into the fireboxes than would be required under proper methods, wastes labor both in handling the fuel and the refuse; the use of an improper quality of fuel has the same result. The greatest waste of labor at the average plant is due to poor arrangement of the facilities for conveying the fuel to a point within easy shoveling distance of the fire doors and in the lack of a convenient method of disposing of the cinders. It is a matter of comparative simplicity to arrange coal bunkers which, without adding any difficulty to the unloading of cars, provide a means of feeding the coal by gravity to a point which enables the fireman to shovel directly into the firebox without taking a step. Every step which the fireman must take decreases the efficiency of his applied effort, and even though but one step is required from the coal supply to the fire door, the total wasted energy in a month or a year is surprising. It is not entirely a question of whether a rearrangement of the fuel bin will enable the firing force to be reduced, although this may often be done. The man who is overworked or who sees that he is doing unnecessary work is not an efficient performer and much of the poor firing observed in power plants may be attributed to the fact that inconvenient facilities have led the men employed to adopt practices which are wasteful both of fuel and labor. The cleaning of fires and handling of cinders is another item which a little study may enable the engineer in charge to so handle as to require the minimum expenditure of time and effort from his firemen and laborers.

The principal need in effecting power plant economies, as in securing like results in any other line, is the provision of records of performance which are accurate and immediate. The man who realizes that the results of his work are intangible does not put forth the effort that he would if his record were comparable with the record of other men or with his own past record. It is, therefore, a matter of the greatest importance that an accurate record should be kept of all the expenses incident to the generation of power and that such reports should be furnished as will show the comparative efficiency of performance from week to week, or from month to month.

No item should be so small as to go unnoticed by the head of a shop and the importance of the power plant in its effect on the cost of output, both directly in the cost of generating the power and indirectly in the effect of wasted or misapplied power, should not be overlooked by the executive in search of economy.

LOCATION OF STEAM GAGES IN SETTING SAFETY VALVES

BY C. T. ROMMEL.

On June 2, 1912, the Interstate Commerce Commission amended rule 35 of the rules governing the inspection of locomotive boilers so that it is now necessary when setting safety valves to use two steam gages, one of which must be in full view of the person engaged in setting the valves. At the same time rule 29 was also amended, requiring the siphon pipe and its connections leading to the boiler to be cleaned every time the steam gage is tested. Before this amendment, rule 29 was as follows:

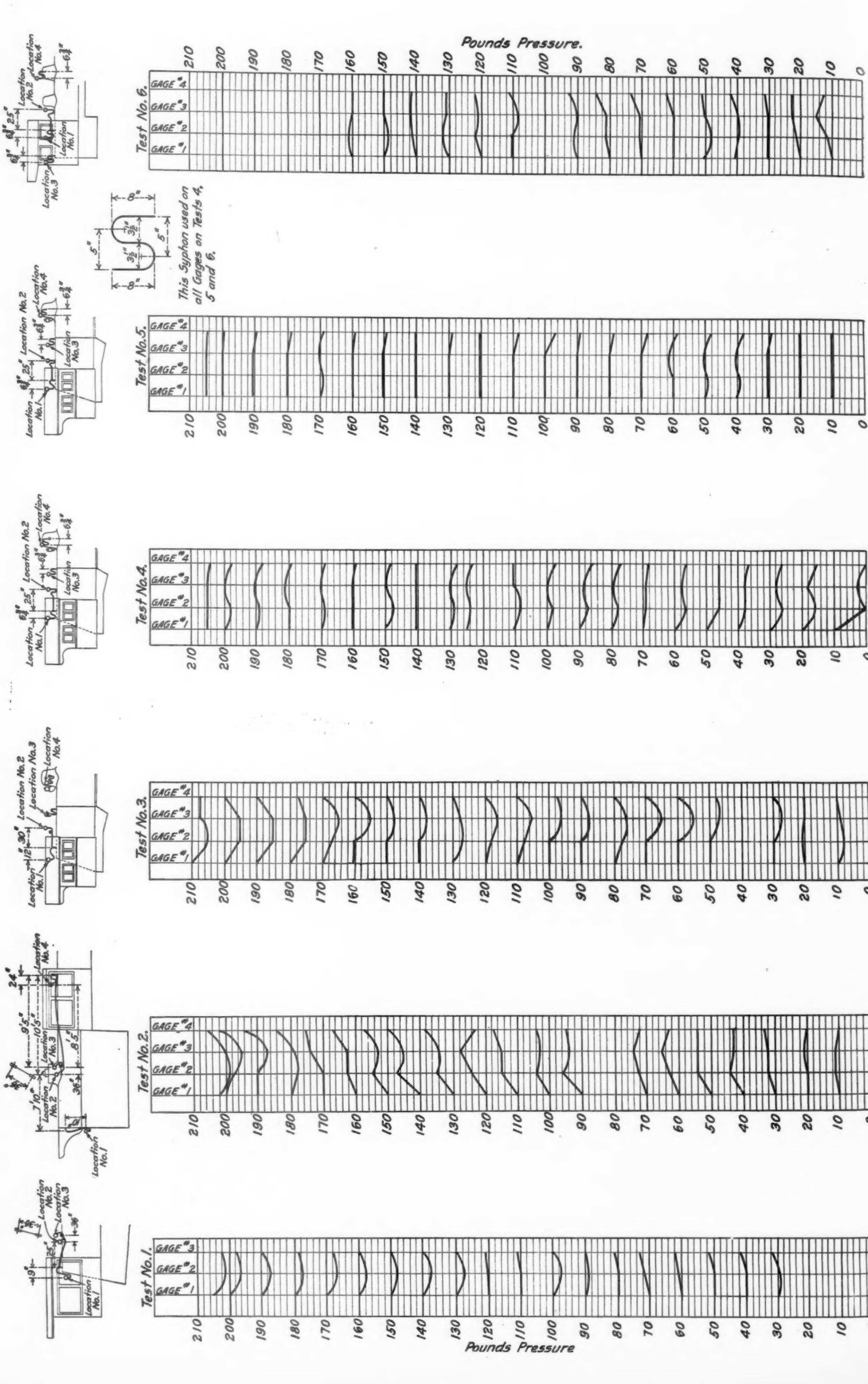
"Every gage shall have a siphon of ample capacity to prevent steam entering the gage. The pipe connection shall enter the boiler direct, and shall be maintained steamtight between the boiler and the gage."

Rule 28 is as follows:

"Each boiler shall have at least one steam gage which will correctly indicate the working pressure. Care must be taken to locate the gage so that it will be kept reasonably cool, and can be conveniently read by the enginemen."

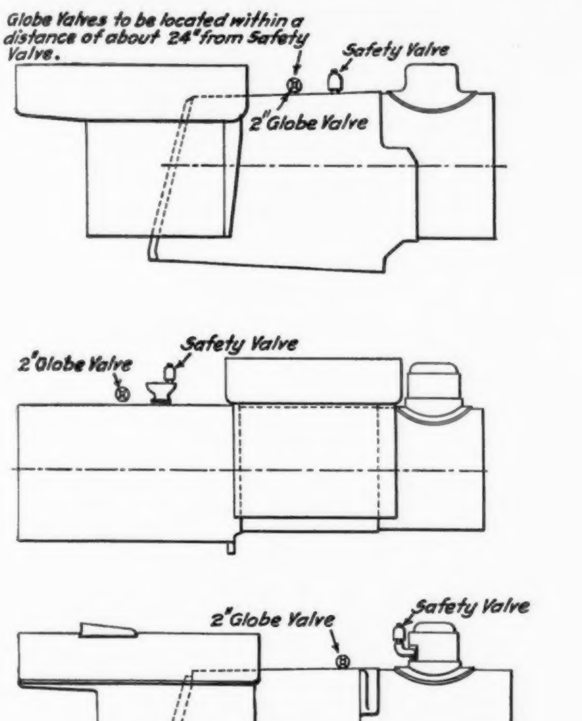
The amendments to rules 29 and 35 do not state where the second steam gage is to be located, neither do they call any particular attention to the siphon to be used with this gage, and the writer believes that to make rule 28 cover this point requires that it be broadly interpreted. The amendment to rule 35 specifically states that if there is a variation of more than three pounds in the readings of the two gages being used, they must be removed and tested before the safety valves are set. The question of the location of this second gage has been a live one with the railroads, as beyond doubt they wish to live up to the full extent of the rules, and it is hoped that this article may be of some help in determining a location for the gage.

In the illustrations, the column headed Test No. 1 shows the



Tests of Steam Gages In Different Locations in Setting Safety Valves.

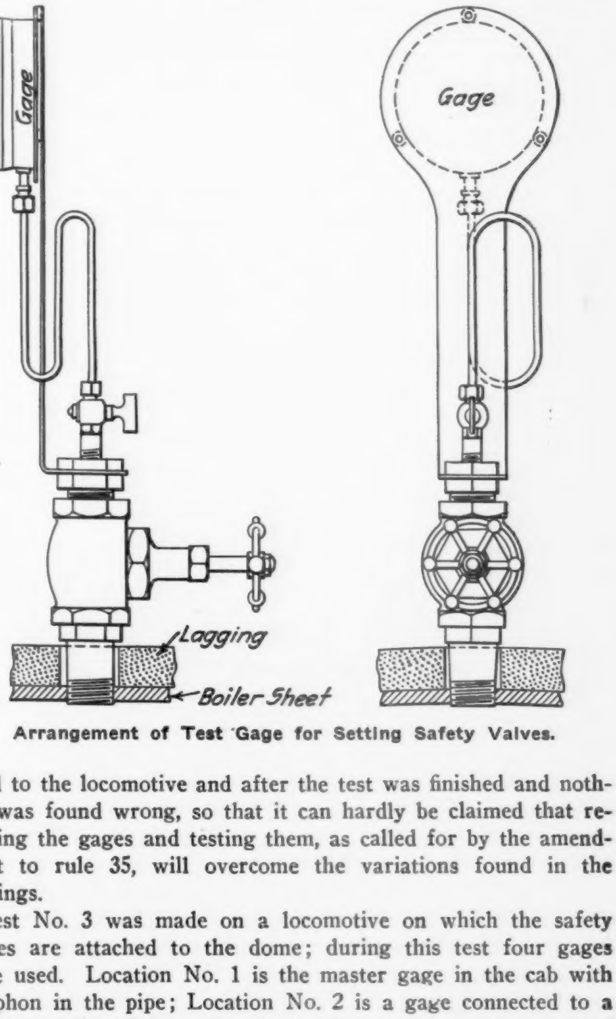
results obtained from tests made on a deck locomotive on which the safety valves are located in the roof of the boiler about midway between the dome and the cab. In the pipe leading to the master gage in the cab a tee was placed, and from this tee a pipe was led outside of the cab and two steam gages attached to it, one with a siphon and the other without; the master gage in the cab also had a siphon in accordance with rule 28. Location No. 1 represents the master gage, No. 2 the test gage without a siphon and No. 3 the test gage with a siphon. The readings obtained are shown graphically from 30 lbs. to 205 lbs., the latter being the authorized pressure for this class of locomotive. These results show that test gage



Points of Application of Test Gages on Different Types of Locomotives.

No. 3, with a siphon, checks closer to the master gage, No. 1, than does No. 2 which did not have a siphon. All three of the gages were tested with a dead weight tester before being applied and all were correct, although they varied during the time the test was being made on the locomotive.

In test No. 2 a Wooten type boiler was used on which the safety valves were located in the roof sheet back of the cab. On this type of boiler two steam gages are always used, as it is not possible for the fireman to see the master gage in the cab. As in the first test, a tee was placed in the pipe leading to the master gage and the two test gages were connected to a pipe leading from this tee, one with a siphon and one without. Location No. 1 shows the gage on the backhead for the use of the fireman; the pipe for it was connected to a cock in the back end of the roof sheet and a siphon was used. Location No. 2 shows the test gage without a siphon, Location No. 3 the test gage with a siphon and Location No. 4 the master gage in the cab, the pipe for which was fitted with a siphon. The results obtained at the authorized pressure of 205 lbs. show that this arrangement would not conform with rule 35, except in the cases of gages 1 and 4. Between the master gage No. 4 and the fireman's gage No. 1 the variation was three pounds; between No. 4 and No. 2 there was six pounds variation (it should be noted that there was no siphon in the pipe leading to gage No. 2), and between No. 4 and No. 3 there was five pounds variation. As it would not be possible for the person engaged in setting the safety valves to see gage No. 1, either No. 2 or No. 3 would have to be used and the variation between these two and the master gage in the cab would be greater than the rules permit. If the fireman's gage No. 1 were considered as the master gage, the test gages 2 and 3 would conform to the ruling, as No. 2 varied three pounds from No. 1, and No. 3 varied two pounds. All the gages were tested before being ap-



Arrangement of Test Gage for Setting Safety Valves.

plied to the locomotive and after the test was finished and nothing was found wrong, so that it can hardly be claimed that removing the gages and testing them, as called for by the amendment to rule 35, will overcome the variations found in the readings.

Test No. 3 was made on a locomotive on which the safety valves are attached to the dome; during this test four gages were used. Location No. 1 is the master gage in the cab with a siphon in the pipe; Location No. 2 is a gage connected to a pipe branching off from the pipe leading to the master gage and fitted with a siphon; Location No. 3 is a gage connected to an ordinary steam gage cock in the roof of the boiler and fitted with a siphon. Location No. 4 is a gage connected to a two-inch globe valve in the side of the dome, and fitted with a siphon. At a pressure of 210 lbs., gages 3 and 4 varied from the master gage three pounds and would conform to the ruling, while gage No. 2 varied four pounds and would not therefore conform.

During these three tests no attention was paid to the siphon used, either as to shape or dimensions, although the pipes leading to all of the gages were the same size. A careful analysis of these three tests showed that the test gages with siphons and a pipe nearly the same length as that attached to the master gage, did not show as great a variation as those without the siphons. From this the conclusion was drawn that the siphon had a great effect on the results obtained and in test No. 4 all the siphons used were of exactly the same dimensions; the results obtained during this test seem to bear out the previously formed conclusion. At 205 lbs. pressure, the location of the different gages being the same as in test No. 3, all of the test gages read close enough to the master gage to conform to the ruling, gages 2 and 3 reading exactly the same, while No. 4 varied but one pound. Test No. 5 was made as a check on test No. 4 and at 205 lbs. the readings were the same as those obtained during test No. 4. From the diagrams it can be seen that the readings obtained during the entire range of pressures were more uniform than when no attention was paid to the siphons.

Test No. 6 was made on a deckless locomotive which necessarily requires two gages, and as in the case of tests 4 and 5, siphons of exactly the same dimensions were used on all of the gages and the same results were obtained. At the authorized pressure of 160 lbs., there was a variation of but one pound between the four gages.

From this it appears that it is possible to obtain a location for the second, or test gage, so that its readings will be near enough to those of the master gage to conform to the amendment to rule 35, provided the siphons used are of the same dimensions as those used on the master gage. From the results of these tests the road with which the writer is connected adopted the arrangement shown in one of the illustrations. This consists of a bracket on which the test gage is mounted and the pipe leading to this gage has a siphon which is applicable to the master gages on all classes of locomotives. The bracket is fastened to a nipple which is screwed into a two-inch globe valve in the roof of the boiler, the location of this valve on the different types of locomotives being shown in another of the illustrations; the distance from the safety valves is about the same in all cases. The globe valve not only provides a convenient connection for the test gage when setting the safety valves, but also a convenient means of blowing off the steam from the boiler.

With the use of this style of test gage and siphon no results can be obtained if the gage is applied and the valve and cock are not opened until almost the authorized pressure has been reached, as the in-rushing pressure is likely to injure the sensitive Bourbon tube in the gage. This fact was determined while these tests were being made. An attempt was made to change the location of the different gages at each ten-pound reading by closing the cocks in the pipe; after the change had been made the cocks were opened and the hand on the gage would jump violently around and then remain fixed, giving no results.

According to the rules, steam gages must be tested but once every three months, and during this time the spring in the safety valve will not take any permanent set if the adjusting screw is properly locked. If the safety valves are reported by an engine crew as not relieving the boiler at the authorized pressure, it is well to first test the steam gage and if it is found to be correct, apply the test gage when the pressure on the boiler is low, opening the cock to the gage gradually. At every three-month period the testing of the steam gage and setting of the safety valves should take place at the time of boiler washing, and the test gage should be applied when the boiler is cool and with all the cocks open; it is also well to fill the siphon with water and see that it is kept so at all times. During these tests it was found that the S form of siphon would generally give more uniform results than any other.

Boiler Explosions.—Of the various types of steam boilers which contribute to the annual list of explosions in England, the small vertical is probably the most prolific.—*The Engineer.*

KINDLING LOCOMOTIVE FIRES

BY E. A. MURRAY,
Master Mechanic, Chesapeake & Ohio, Clifton Forge, Va.

The increasing cost of crude oil has led to much serious thought as to how best to make a reduction in the cost of firing up locomotives. Upon making a test by using shavings without being oil soaked, it was found that the oil could be omitted without any noticeable effect in the time required to generate steam, in fact any difference was in favor of the method of firing up without the oil. This is accounted for by the quickness in which the shavings will burn when oil soaked, whereas without oil it has been found that the flame will be of longer duration and will necessarily ignite the coal better; especially is this true when using slow burning coal. The consumption of fuel oil at this point averages 50 gals. each 24 hours. By eliminating the use of oil, a saving of $56.25 per month or $675 per annum has been accomplished.

FIRING-UP HOUSE FOR LOCOMOTIVE TERMINALS

BY PAUL R. DUFFEY

A house for firing up and finishing locomotives when they are taken out of the erecting shop is something which should be provided, unless a stall or two in a nearby roundhouse are set aside for this work.

In the erecting shop quick work is necessary to avoid delaying the movement of locomotives into and out of the shop. Frequently locomotives, when nearing completion—or sometimes as soon as mounted on the wheels—are pulled out of the shop and placed over a pit near by so that the piping, valve setting and other final work may be done; the firing up is also done on this pit so that the air brakes and boiler may be tested under steam. During inclement weather much time is lost from the men's inability to do their work well under such conditions.

The finishing or firing-up house should be of sufficient size to conveniently accommodate the output of the shop; for the average shop a building 75 ft. x 100 ft. x 25 ft. 9 in. high will give very good results and the pits should be spaced 24 ft. between center lines, the center line of the first being 13 ft. 6 in. from the wall. A smoke jack should extend across the three pits with a large outlet at the center through the roof of the building. This smoke jack should be about ten feet wide at the bottom to permit of moving the locomotive ahead or back a short distance without filling the house with smoke. A crane should be installed for lifting air pumps, dome casings, stacks, etc., and there should also be a few benches and vises in order to avoid the necessity of the men returning to the shop to do any work that may develop when the locomotive is under steam.

Large doors should be provided at both ends of the house so that there will be plenty of light and ventilation and also that material may be brought in or removed from either end. The upper half of the doors should be glazed and there should also be a sufficient number of windows in the side walls. The pits should be of concrete, capped with 12 in. x 12 in. wooden sills, special attention being given to the matters of depth and drainage.

Boilers in New Zealand.—In New Zealand all steam boilers, other than on government railway locomotives, must be certified to be safe for work by the inspector of machinery department every year. In its annual report to parliament the department states that during the past year 7,011 boilers were examined, and that in 1,239 cases defects were discovered, of which 33 were very dangerous. The new boilers registered during the year numbered 587, with a total of 6,649 horsepower.—*The Engineer.*

SHOP PRACTICE

SHOP KINKS

BY C. L. DICKERT,
Assistant Master Mechanic, Central of Georgia, Macon, Ga.

PLANING SHOES AND WEDGES.

The planing of shoes and wedges may be accomplished in a satisfactory and economical manner by using the chuck and combination tool shown in Figs. 1 and 2. With the chuck shown in Fig. 1 the frame fit and outside of the flanges may be planed in one operation. The chucks are made in 4-ft. sections and as many as possible are placed on the planer. Where the planer has two heads on the cross-rail two rows may be set up, as each head equipped with the combination tool shown in Fig. 2, will finish one row of shoes or wedges. The shoes are clamped by tightening up the nut *A* on the chuck rod, and they are held tight enough to take any cut or feed desired. The two end jaws are adjusted in and out by the bolts, which are threaded in the bottom of the jaw. Four sections of the chuck will take from 8 to 11 shoes.

By using the combination tool the cost of planing shoes and wedges has been reduced to four cents a piece. This tool will finish the shoes and wedges on the inside and outside at the same time. The outside tools are adjusted to the size the shoes and wedges are to be finished. The tool for planing the inside is made of one piece and to the size of the finished shoes. The ¾ in. x 1½ in. tool placed on one side of the tool holder is used to plane out the bottom of the shoe or wedge, removing the scale to allow the inside tool to make a smooth finish on the bottom. This tool holder eliminates the several changes that are necessary when single tools are used.

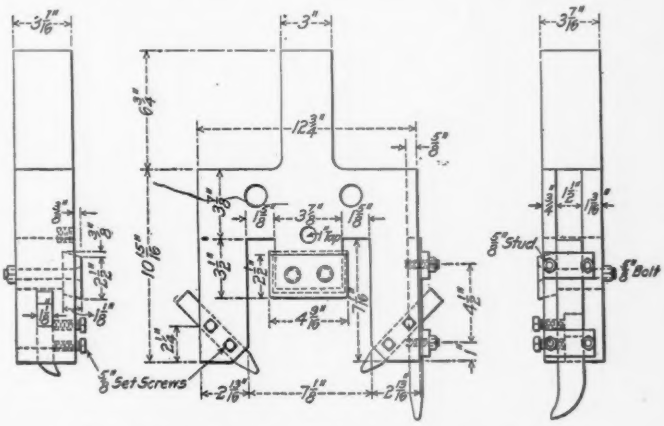


Fig. 2—Gang Tool for Planing Shoes and Wedges.

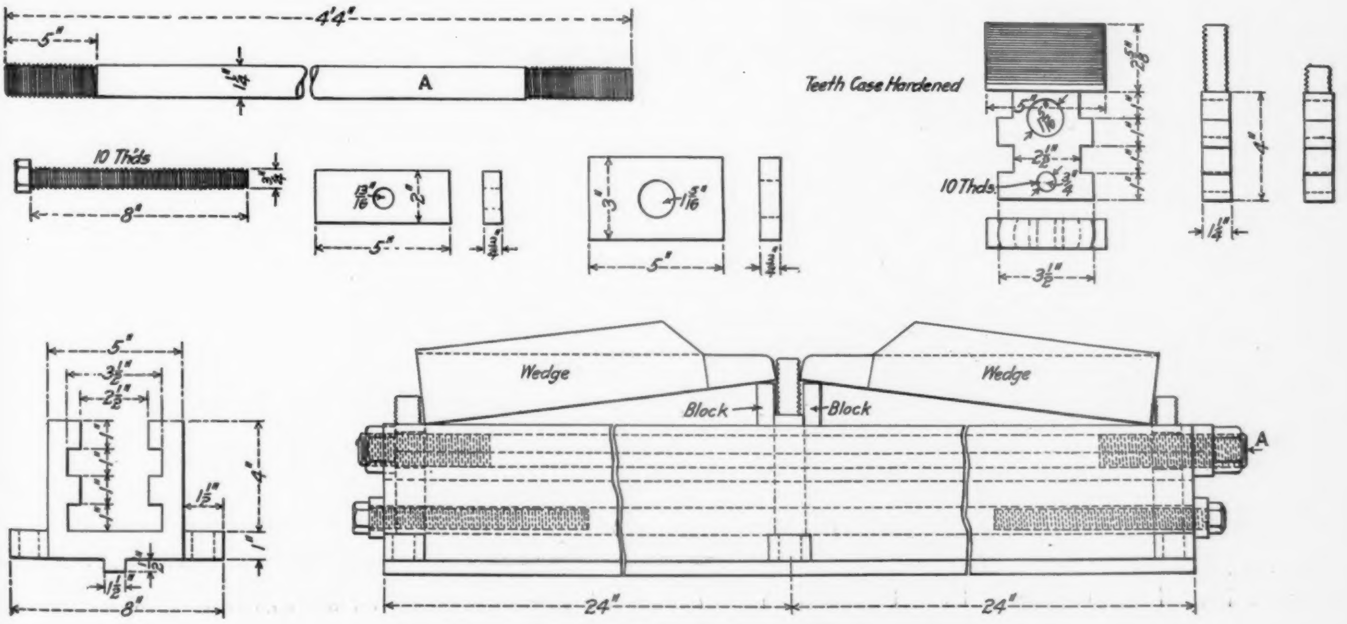


Fig. 1—Chuck for Holding Shoes and Wedges for Planing.

AUTOMATIC AIR LIFT FOR PLANER TOOL HEAD.

The automatic air lift shown in Fig. 3 is applied to a planer where a heavy tool is used. By its use the tool is kept from dragging on the back stroke, thus preventing the cutting edge from wearing away or breaking off. This lift is used to great advantage when planing shoes and wedges with the combination tool holder shown in Fig. 2. There is an air cylinder on each head so that they may be used independently of each other if so desired. The air pressure is reduced to about 20 lbs., which provides just enough force to raise the tool slowly. Air is admitted and released automatically by means of adjustable stops on the table of the planer, which operates a three-way valve that is clamped to the side head tool post. The whole apparatus may be set up and removed in a short time.

TIRE SETTING GAGE.

It has been found impossible to set tires accurately by measuring from the inside faces as the surfaces are not machined and are often uneven. This led to the method of setting tires from the throat of the flange and to do this the gage shown in Fig. 4 was made. It consists of two rods 1⅛ in. in diameter fitted with gaging points at one end. The other end of one rod is held inside a 1½ in. knurled tube by a pin, while the other rod is free to slide in the tube and is held in it by a spring. An indicator pin is fixed on the sliding rod and slides in an indexed slot in the tube which is divided into 1-16 in. spaces. There are two zero divisions on this scale which designate the minimum and maximum limits. The overall length of the rod is made to suit the requirements. When testing the tires all that is necessary is to spring the gages over the flanges of the tires, the spring bringing the points of the gages hard against the throats of the flanges. By this means the tires are accurately set on the wheels, true with the throat of the flange, instead of from back to back of the tires. The gage on each end is the standard P. & W. maximum tire gage.

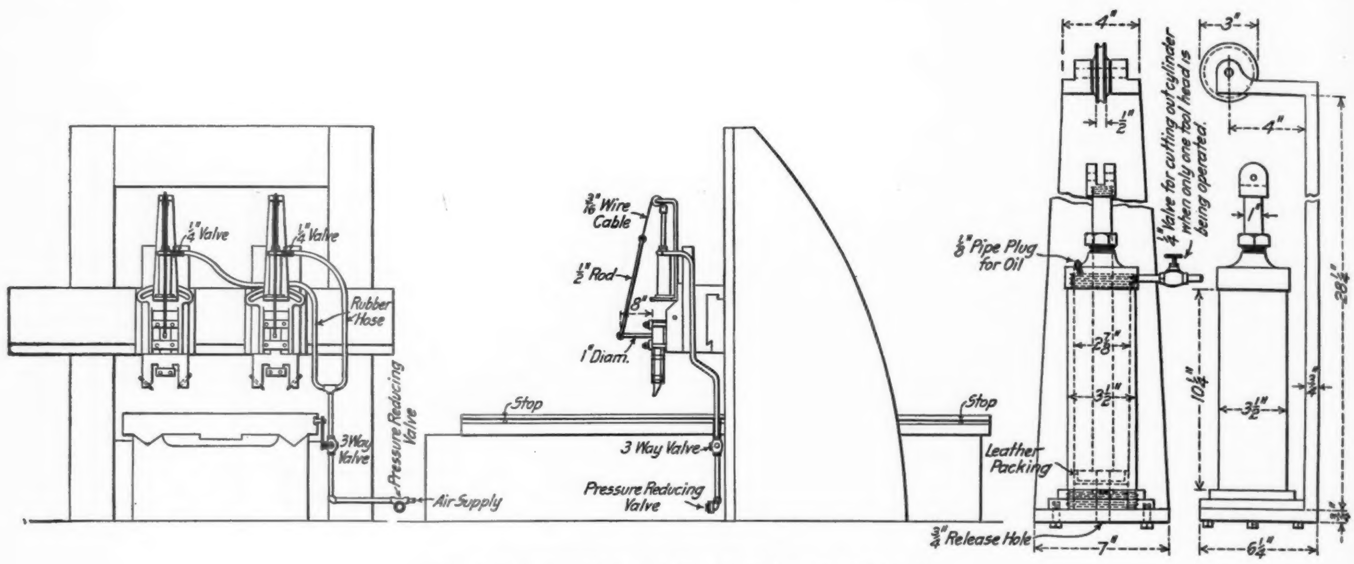


Fig. 3—Automatic Air Lift for Planer Tool Heads.

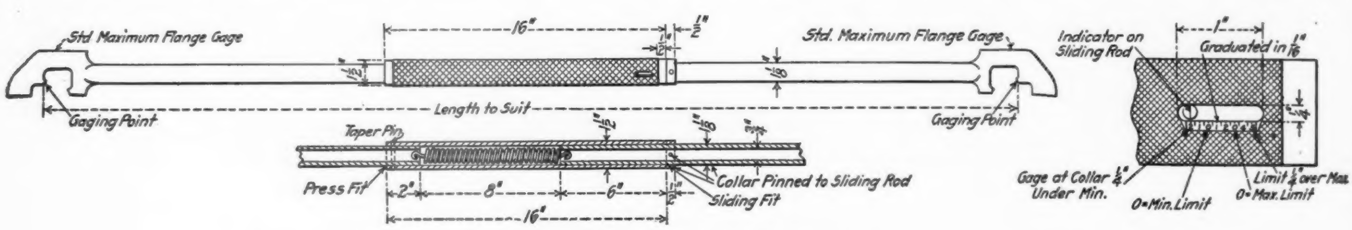


Fig. 4—Spring Gage for Setting Tires.

PEDESTAL BINDER HOIST.

The air hoist shown in Fig. 5 has been found convenient in lifting the pedestal binder on heavy power when fitting it to the frame and also while squaring up the shoes and wedges. It is simple in construction consisting of a 4-in. cylinder having a stroke of 11¾ in. The top cylinder head is fastened to a hook made of 6 in. x ¾ in. bar iron as shown. The lower hook has two prongs and has a swivel connection on the bottom of the rod. This little device has proved valuable in the erecting shop and materially reduces the labor in handling this class of work. It is light and may be easily lifted from one pedestal to another by one man.

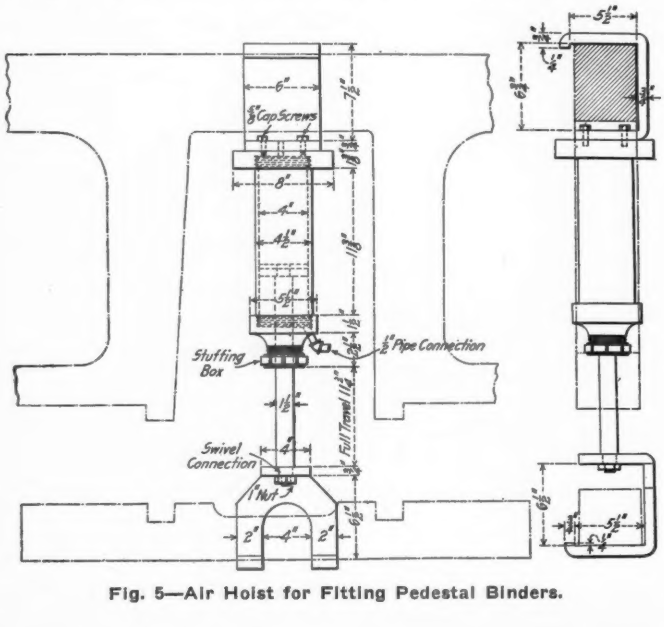


Fig. 5—Air Hoist for Fitting Pedestal Binders.

UPSETTING BRAKE STAFFS.

The ram and dies shown in Fig. 6 are used to upset the ends of solid end brake staffs from a diameter of 1¼ in. to 1½ in. The rams are made in two lengths, the shorter one being used to start the upsetting and the longer one to finish the operation. The female dies are made in two parts as shown. The end of the brake shaft ready for application is shown at *A*. The dies are fitted to a 4-in. Ajax forging machine.

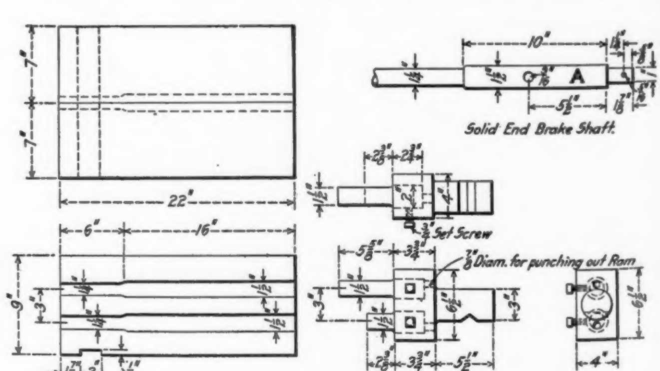


Fig. 6—Dies for Upsetting Brake Staffs.

MASTER PAINTERS' ASSOCIATION

Care of Steel Cars, Rust Inhibitive Paints, Safety First, and Brushes for Painting Steel

The forty-fourth annual convention of the Master Car and Locomotive Painters' Association was held in Ottawa, Canada, September 9 to 12, President A. J. Bush, master painter of the Delaware & Hudson, presiding. The opening prayer was offered by Rev. W. A. McIlroy of the Stewarton Presbyterian Church. J. A. Ellis, mayor of Ottawa, also a member of the provincial parliament of Ontario, and Dr. R. H. Parent, one of the four comptroller, welcomed the association to the city. C. A. Copp, master painter of the Boston and Main, responded to the addresses of welcome, stating that the last time this association met in Canada was 28 years ago when the convention was held at Toronto.

PRESIDENT'S ADDRESS.

President A. J. Bush in his address spoke of the successful work of the various committees, especially that of the information and test committee. Both these committees have given the association some very valuable information, and it is hoped that more of the members will make greater use of the information committee. He exhorted the members to participate freely in the discussion and to do everything in their power to make the work of the association a material success.

FINISHING STEEL PASSENGER CARS

Two papers were presented on this subject, one by John Gearhart (Penna.), and another by H. M. Butts (N. Y. C.). Mr. Gearhart described the baking process by means of a large oven which the Pennsylvania have placed in service at Altoona, Pa.* This oven is large enough to accommodate the largest car on that road, being 90 ft. 3 in. long, 13 ft. wide and 15 ft. high. This oven is heated by steam coils, having a total surface of 2,741 sq. ft.; the ratio of heating surface to cubical contents being one to six. This oven has been heated to as high as 305 deg. It is believed that the temperature can be raised to the desired degree in from 2½ or 2 hours without affecting the durability of the paint. With this oven it is possible to paint two cars complete in 6½ days, the saving in time on new cars being between 7 and 10 days over that of the air-drying system. The advantages of the baking process are that the cars may be finished on schedule time, the temperature and weather conditions can be more carefully regulated and there is no interference by workmen of the other trades while the paint is drying. Two 54-ft. passenger cars, four 78-ft. dining cars, six 70-ft. baggage and mail cars, four passenger locomotive tenders, and 20 steel hopper cars have been baked in the oven at Altoona, and 1,000 steel freight cars are to be baked at the oven at South Amboy, N. J., next month. Experiments are being made with non- and semi-drying oils on freight cars. Japans or other artificial driers are not used in this baking process.

H. M. Butts (N. Y. C.): With the advent of the steel passenger car it was thought that many radical changes in our present methods of painting wooden cars would become necessary in order to maintain as fine and as smooth a finish on steel cars. By some the fact has been completely lost sight of that we have been sucessfully painting steel on cars and locomotives for many years. To the master painter the painting of a steel passenger car seems easy in comparison to painting a locomotive tender which is fraught with many and greater difficulties. Nevertheless much valuable time and money is being expended to produce a more durable and less expensive method than the old reliable ones in use for generations. However, it yet seems to be an open question whether very much real progress has been made along these lines.

The process of baking the paint and varnish mixture is not new, but has long been in common use. However, as applied to passenger cars it is comparatively new, and largely in the experimental stage. The various formulas are very imperfect and cannot be relied on as giving the proper proportion of material which can be safely used in mixing the various colors for the baking process. J. W. Lawler, chief chemist of the Pullman Company, says that results and experience based on practical tests show that the life of a baked paint on steel is greatly prolonged, its adherent qualities are increased and it has the additional value of being much more impervious to moisture and gas than the same vehicle unbaked.

Allowing this statement to be correct, has it been fully determined whether its life has been really and wonderfully improved? It is a commonly accepted fact that slow drying and more elastic vehicles will resist moisture and severe atmospheric changes for a much longer time than a quick, hard drying one, also that very soon after a vehicle loses its elasticity, decomposition sets in and complete disintegration is very near at hand. Immediately after baking, a vehicle becomes hard and brittle, which justifies the assumption, does not baking hasten its destruction? A sufficient exposure or service test can only satisfactorily answer this question. Baking the interior separate from the outside is being tried with considerable success by the Hudson & Manhattan of New York City. Electric heaters are suspended from the ceiling, the windows and doors being closed tight, thus enabling a proper amount of heat to be generated to accomplish the baking. This test seems to have determined the fact that the best results are obtained with thin mixtures of paint composed of very elastic vehicles with a small amount of pigment. It has also been proven by actual test that pigments when baked become hard and brittle, therefore the less amount of pigment added to the vehicle the greater will be its life and durability, likewise the lower the temperature and the longer time the paint is baked the better it will wear. Twelve hours at 180 degs. F. is better than 5 hours at 280 degs. The preparation of the metal before the paint is applied has also been given attention. The evidence produced is largely in favor of the sand blast over the pickling process.

The prevention of corrosion of the metal seems to be the most difficult problem which confronts us. Numerous mixtures claiming to prevent corrosion are on the market. There is no reliable evidence at hand which proves that any of them can be safely used for painting passenger cars. Most of the so-called rust preventatives are only suitable for use on structural steel, such as is used on bridges and buildings. A somewhat radical departure by a well known paint and varnish company from the old established rule that a primer suitable for use on wood must be made considerably more elastic than if it were to be used on metal has come to my notice. They recommend the same primer with their surfacing system for both wood and metal. There seems to be abundant evidence that a primer of this character can, and is being safely used. The New York Central is using the same priming coat for both wood and metal. We have in service about 200 steel passenger cars which were painted about 7 years ago with one of the surfacing systems, well known to us all, which are making a very excellent showing. The surface of these cars was first thoroughly sand blasted, then primed and surfaced in the old fashioned way.

Painting the interior of steel cars involves much the same problem as the exterior as far as the priming and surfacing is

*A description of this oven and the method of painting used in connection with it appeared in the *American Engineer* of May, 1913, page 245.

concerned. The only departure from old tried and true methods is the baking on of the priming, which is being done by the Pullman Company before the work is assembled. The surfacing and finishing is being done in the usual way. For information as to the value of the various pigments used in mixing paint, and their adaptability for painting steel, we are dependent very largely upon chemical analysis.

DISCUSSION.

H. M. Butts (N. Y. C.): If a paint can be dried artificially without the use of a liquid drier its life and durability will be increased and this feature alone would make the baking process worth while.

John Gearhart (Penna.): The surfacers used have been prepared in our own laboratories. We have been experimenting with six or eight different varnishes. Some we find will bake better than others; some became flat after rubbing, while others looked the same as if they were air-dried. The cars baked last February are in much better condition at the present time than those that were air-dried. Baked dining cars running in the tunnels at Washington, D. C., appear to be in the same condition after the eighth cleaning as the air-dried cars after their fifth cleaning. The air-dried finish on the car does not behave like those on the test panels, the test panels being much shorter lived than the cars. The baking process is practical and looks economical, but it will be a year or so before definite information can be obtained.

We have used varnishes that caused the job, when finished, to be rather tacky, perhaps a little more so than it should be in order to rub successfully. Another trouble was that finger marks would show. But those varnishes, after being out now about five months, are just about the same as the others. I believe that the fish oil made the best job of any; we used that on freight cars, giving them two coats. The first coat looked nice and glossy, and the second coat flattened. The paint was applied by the spray. We find no trouble at all in drying when using the fish oil even when no dryers are used.

You have got to know your material and just what it will stand. We have one varnish where we ran the heat up to 210 degs. F. and left it in the oven all night at 150 degs., and still it was not any dryer the next morning than it was the night before. In the inside of the cars it was a little harder to rub than the air-dried. The luster of the varnish on the cars that we have baked is much better than the air-dried. The reason for that, I think, is that it did not have the amount of cleaning to get the dirt off as it did on the air-dried.

We commenced baking in February, and we could then throw open the windows and cool a car in an hour or an hour and a quarter, but in the last month or six weeks, during the hot weather, we had to wait two hours and a half for a car to cool. It has to get pretty cool before you can apply the next coat successfully so that it will not lap. I am going to try this winter to run in a car and make it very hot, and then run it out into the cold, and see if it will not crack off the paint, as I believe we will be better able to get the old paint off in that way.

J. H. Pitard (M. & O.): Our traveling inspector told me the other day that a foreign steel freight car, passing through the yard, suddenly broke in two in the middle. He made an examination and found that the iron had been eaten away where it broke by the rust. While this is an exceptional case, I mention it to show what rust will do to a steel car if it is neglected. Possibly in a few years we will have more of that sort of cases if the steel freight car equipment is not given better attention.

C. F. Mayer (C., St. P., M. & O.): We received our first steel cars in 1910 and the paint on them has given very poor satisfaction. The average life will be about thirty-six months. I think the trouble with them is that they have been surfaced too heavy at the factory. The lighter the cars are surfaced the longer will be the life of the paint. Some of the cars have been repainted by the old process. Two of these have been in service sixteen months without shopping, and they are giving good results.

Mr. Gearhart: Our cars are all steel, except the sash in the dining cars, and we have had no trouble with them when baking. The wood is well seasoned, but I suppose if you had wood that was not well seasoned you might have trouble.

Mr. Butts: Quoting from Mr. Lawler's article: "The baking produces an extremely hard and durable coat. Up to the present time, when it is necessary to refinish such a car, we have not found any chemical which will successfully remove the baked surface." It seems to me there would be difficulty there when the car comes in for repairs.

Mr. Gearhart: We have had no trouble in repainting. However, I believe it will not be safe to use as high as 250 degrees of heat, and it may be necessary to use a little dryer to get it to dry, but we will have to use a lower heat.

John D. Wright (B. & O.): raised the question as to whether it would not be feasible to raise the temperature of the paint shop each night to 150 deg. or more so as to force the drying along. This has been done at other shops and was found to be considerable trouble. On the D., L. & W., however, this method is in use and is giving good results.

Further discussion brought out the fact that a low temperature and a longer time would give better results in baking than a higher temperature and a short time. Many also believed that better results could be obtained by having as few coats of paint on steel equipment as possible.

TEST COMMITTEE'S REPORT.

Oscar P. Wilkins (N. & W.), chairman of the test committee, read the following report:

In order to determine the actual relative value of paint stock it is necessary to make service tests under normal conditions, but as it requires long periods of time to accomplish satisfactory results, we find in the test panels a good medium for making comparative tests. Accelerated tests under abnormally severe conditions are misleading unless the results obtained by the method selected will be in harmony with long time service tests. Therefore in making a panel test we should adhere closely to the line of actual practice in preparing the panel, and the exposure should be consistent with that of actual service.

The test panels of varnish exposed for 12 months beginning July, 1912, and which were referred to in the last year's report, were prepared in accordance with these views. We consider the test an accelerated one, but one that indicates the comparative value of the varnish samples involved. The samples were secured from various master painters who are members of this association, and were taken from the regular purchased stock. The wood panels, 14 in number, and 5 ft. long, were cut from the same piece. They were finished with the same priming, surfacing and coloring materials in exactly the same manner as a new wooden passenger coach. Three coats of varnish were applied to each panel, 48 hours being allowed between the coats for drying. All operations were performed by the same man, and as near the same time as possible. The panels were allowed to stand one week after the last coat of varnish had been applied, for hardening. They were then sawed into 1-ft. lengths and a panel of each sample sent to H. M. Butts, Albany, N. Y.; J. H. Pitard, Whistler, Ala.; T. J. Hutchinson, London, Ont.; A. P. Dane, Reading, Mass.,* and one set was retained at Roanoke, Va.

An examination of the test panels showed that the southern climate is the most severe on varnished surfaces; that there is a difference between all the samples tested; also a difference between the results obtained on the same varnish at different points.

One of the most noticeable features of the test is the gen-

*An unfortunate circumstance connected with the set of panels sent to Reading, Mass., prevented their exposure in time to be considered with the test, therefore they are not included.

erally superior condition of panels exposed in the North over those exposed in the South. The test furnishes a good opportunity to select varnishes that might be expected to render the best service in any of the zones represented. We secured these samples with the understanding that we would not publish names, etc., therefore we will not make a detailed record of the standing of each panel. The committee will be glad to furnish detailed information to any master painter who may be interested in the test.

H. A. Polhemus (Erie), a member of the committee, submitted the following on baking enamels:

To prepare a car body for enameling, remove all grease with gasoline and, if necessary, sandblast the surface to remove all the rust and scale. This must be done to insure a perfect and lasting job. Immediately after sandblasting give the surface a thorough dusting and apply a coat of priming enamel. Never let a sandblasted job remain over night without priming, as it will rust in a very short time. A steel passenger car when shopped for general repairs can be completed in less than half the time by the enameling process than by our present air-drying system, if there are proper facilities for doing the work. If the work is properly done, enameling will outwear the air-dried job by two years or more service, and the surface of the car is easier cleaned and the appearance is 100 per cent. better.

Mr. Polhemus exhibited several interesting panels of enamel work.

The test committee exhibited other specimens, among which was a film 5/8 in. thick representing 365 coats of an oil retarded black carbon paint, each coat being applied daily during the period. When the film was finally lifted it was found that 38 per cent. of its weight had been lost, due to oxidation. Another film represented a retarded surfacing system which embodied 11 coats, applied in 12 days. Other films represented the practical oil retarding of the first class quick setting up paint oils found on the market. One was retarded with a high grade fish oil and another with the soya bean oil. It was recommended that these be given a good atmospheric test during the next year.

RUST INHIBITIVE PAINT

W. A. Breithaupt and A. M. Johnsen (Pullman Company): Sheet steel as it is usually received from the mills has a surface coating of mill scale. If this mill scale coating was uniform in thickness over the entire surface and if it would stand heat and bending without chipping off, it would be desirable to leave this coating on the steel. The fact is, however, that it does in no way fulfill these conditions satisfactorily.

The sandblast, according to our experience, is the best method for removing this scale and rust. The steel should be painted immediately after sandblasting, or if it is not convenient to do so it should be placed in a room warmer than the outside temperature in order to prevent the condensation of moisture on the steel.

Sandblasting the steel provides a sufficiently roughened surface for the paint to thoroughly adhere to. The paint coats must be of such material that the vehicle or combinations of oils and varnishes give the pigment a coating which will resist to the utmost capacity the passage of moisture and gases. The pigment must also be alkaline to a slight extent and electrolytically positive to the steel.

The Pullman Company have made a large number of tests on such protective coatings for steel, and now believe that the lesser the number of coats possible to give the desired protection, the better it will last. Where previously the 7 or 8 coat system was used we found that three coats of paint would give the desired capacity and ample protection to the steel. We then began the five-coat system, applied as follows: primer, body color, varnish color and two coats of varnish. The priming coat is made with an inhibited pigment as a fundamental requirement and a vehicle of good adhering quality. The prime factor of the second coat lies in the vehicle which must be the very best moisture and gas resister than can possibly be obtained. The pigment was also a very good inhibitive. The steel plates are dipped in these two first coats and baked at 240 deg. F. for 12 hours. Cars so painted have been in service thirty months, without the slightest indication of destruction of the paint. The outside surface was entirely free from checks and cracks and as a general assertion would state that the paint was in excellent condition.

A. J. Bishop (Nor. Pac.): While the baked surface on steel is perhaps a better inhibitive coating than ordinary or even special painted surfaces, it has several objectionable features besides the one fact that it does not entirely prevent rust. J. W. Lawrie, Ph.D., in a paper before the World's Eighth Congress of Applied Chemistry, states "that while it is true that the problem of the preservation of steel is not new to us, the artistic preservation and protection of steel from corrosion is a new problem. A railway passenger coach must not only be painted carefully, but it must be painted so as to be and present a pleasing appearance to the eyes of the traveling public."

Paints for steel have different functions than those for wood; therefore in painting equipment constructed with wood and steel these functions should be carefully noted. We have not the absorption into the pores of steel only to a limited extent, and for this reason a different quality of paint is required to secure stronger clinging effects than that of the pores of wood. While it is undoubtedly true that sandblasting gives a slightly roughened surface which aids materially in holding the paint to steel, it is necessary to assist an oil paint with something that is better as an adherent to steel than linseed oil. The fewer the number of coats of paint on steel which will give the maximum protection, the longer the wearing and the better service will the paint coats give. The pigment and vehicle must be such as to exclude from the steel surfaces all moisture and gases.

It matters not what coating is to be applied, special attention should be given to the application of the priming coat, especially on metal.

DISCUSSION.

John Gearhart (Penna.): In Mr. Breithaupt's paper he states that they give four or five coats of material. I realize very well that the Pullman Company's steel is a very thin and smooth steel. If we had that kind of steel we would not have to put any surfacer on at all outside of our priming; and in fact we do not do that on the inside of our cars at the Altoona shops, as the steel on the inside of the cars is much smoother than on the outside, and we only give it a coat of primer and go on with our ground coats. Outside of the car the surface is much rougher, and we have to give it a certain number of coats to make its appearance come up to the standard that we try to maintain.

ECONOMY IN LOCOMOTIVE PAINTING.

D. A. Little (Penna.): When ultimate economy is considered the present practice of cheapening the cost of locomotive painting is undesirable. With very few exceptions the present practice of painting locomotives is not economical in any degree. Time was when locomotives were painted with the intention of securing a reasonable degree of durability and appearance commensurate with the amount of time, labor, and material expended thereon. I am not referring to the old-time method in vogue during the sixties and early seventies, when locomotives were given a carriage body surface and elaborately scrolled and artistically landscaped.

About eighteen years ago, a motive power officer on a certain railroad declared it useless to paint engines as they were then painted, which, by the way, was the most economical and common sense way an engine has been painted since the existence of railroads. He advocated painting them like bridges, using one or two coats of oil paint. His suggestion was, of course, commented on both favorably and unfavorably, and those who looked upon it favorably began to act and immediately a wave of reform swept the railroad paint shops of the country. The cost of engine painting, then reasonable, has been gradually growing less and the average foreman painter demurred not. If he did, it was so meek and humble that it had no effect, and he drifted into the same rut, contenting himself with the false conclusion that if his superiors wanted it done that way, he had no right to object. But was he right in his deductions? The best reply I can make to this inquiry is contained in an article published in the May number of the *Painter's Mazazine,* under the heading of "English vs. American Methods of Locomotive Painting." I will read it now, as it is interesting, and I will incorporate it as part of this paper.

"H. W. Jacobs, formerly assistant superintendent of motive power of the Atchison, Tokepa & Santa Fe, makes conspicuous comment on the beautiful appearance of the British locomotive in an article on "Impressions of British Railway Practice," recently published in the *Railway Age Gazette.* He avers that fourteen coats of filler, paint and varnish are applied to the jacket, cab, tender and wheel-cover. This painting, Mr. Jacobs was informed, lasts from five to seven years, the locomotives not being repainted at every shopping. Immediately upon reading Mr. Jacobs' deductions the question arises, which method in the long run is the more economical? Painting every seven years and then painting very thoroughly, in comparison with the practice of repainting at every shopping of the locomotive, offers an opportunity for our master locomotive painters to do some problems in economy. It is evident, however, at the outset, apart from the question of economy, that British railway people believe there are important advertising possibilities in the locomotive flaunting a superior finish.

Reasonable specifications for painting the locomotive should provide for the outside of the cab one coat of primer, three coats of surfacer, one coat of color, one coat of varnish color, and two coats of engine finishing varnish. For the cab interior, one coat of primer, one coat of filling pigment, two coats of cab enamel, and for a strictly first-class job, one coat of engine finishing varnish. Engine and tender, which includes sand-box, dome, bell-stand, cylinders, driving-wheels, tank, tank frame, etc., one coat primer, one coat surfacer, one coat flat color, one coat varnish color and two coats engine finishing varnish. The jacket should receive two coats engine jacket enamel. Front end and smokestack to have at least one good coat of black finish. While this finish furnishes only a trifle more than half what Mr. Jacobs assures us the British locomotive gets in the matter of coatings, it at least provides a fair foundation for repainting as the machine is shopped from time to time."

I would not advocate such an elaborate system as that of the English railways, but I would advocate a system such as was generally used about twenty years ago, which was good enough for all intents and purposes—reasonably cheap in cost and as durable as could be desired. At the present time our business is simply to get it done before the machinists are through, even if done piecemeal, and that is the usual way. To do this, we must use quicker drying paint and varnish than should be used in durable painting.

J. W. Gibbons (A. T. & S. F.): There are some roads that only consider the first cost when painting their equipment and endeavor to get along with cheap material. This is false economy. The Santa Fe uses a good durable material for their locomotives which is applied in a thorough workmanlike manner, believing, by so doing, that the saving in maintenance will more than pay the difference between the cost of the second rate paint and the first class paint. The formula for the paint should be based on the kind of material on which it is to be used, on the service it is to be used in, and on the treatment it is to receive after it is in service. The paint on a locomotive is subjected to most severe treatment but has given excellent results and it is surprising to hear of the difficulties experienced with the steel cars.

The steel underframe of tenders very seldom receives the protection it should. The overflow of the water and the wetting down of the coal seeping down through the coal becomes of an acetic nature, and when it reaches the underframe will lodge there and greatly augment the corrosion. One coat of paint applied when the tender is built and not maintained is not enough.

W. E. Woods (N. Y. C.): The use of cheap materials for painting locomotives has not proved economical, both from appearances and durability. The New York Central Lines are to rewrite the schedule for painting locomotives to conform to the Master Painters' Association standards.

PAINT BRUSHES FOR STEEL EQUIPMENT

E. F. Bigelow (N. Y. C.): The surface of steel cars is unusually flat apart from the riveting, and I see no reason why the same brushes will not apply to steel cars as to wooden cars. We are using a 5 in. brush now for covering cars and a large 8-0 oval paint brush for surfacing, which is about as large as a man cares to handle. We find that the oval brushes carry paint better and put on a more uniform coat than flat brushes do, considering the amount of work. I would not recommend flat brushes for use over a surface that has been riveted. But for cover brushes we use wide 5-in. civit hair brushes, a varnish brush, as it is equivalent to an 8-0 thumb, a little larger than a thumb brush, the hair being a little longer. And our varnishers, as a rule, use this large oval brush to apply the varnish, using the thumb brush to level the paint afterwards.

H. M. Butts (N. Y. C.): We have recently revised our brush schedule, cutting down the number of brushes carried and selecting those which we have tried out and found to be well adapted for all kinds of work. We did not have in mind when we were doing that that we needed anything particularly different to paint a steel car that we needed for a wooden car. Many of us have had years of experience in painting steel tanks, and I would like to have anybody tell me the difference between a surface of steel on a locomotive tank and on a steel car. Any man who can paint a steel tank need have no fear about painting a steel car, and in fact they are much easier to paint than a tank.

J. A. P. Glass (Y. & M. V.): We use the same brushes on the steel as on the wooden cars. We use the largest one we can get on the steel cars because it is all piecework. In these days of rush work, it is a case of having to get the paint on. And another thing, you cannot convince me that getting a good heavy coat of paint on a steel car or a box car is a detriment. We do not like to have paint thrown away, but I like to have a good honest coat on, and when you ask a man to put on a yard of paint for less than a cent you cannot expect him to brush it down the same as he would if he got better prices.

A. P. Dane (B. & M.): I claim that a man can put on a flat color with a 4-in. brush better and more evenly than he can with a 5 flat.

Mr. Butts: I have to differ about the use of the smaller brushes. A number of years ago we used a 2½-in. camel's-hair brush for flatting, putting our body colors on the coaches. We then went to 3½-in. brushes. I found the work was done better and quicker. Then we increased to 4, 4½ and 5-in., and every stage of that increase was an improvement. We used to pay $2.50 for flatting an ordinary passenger car, and our men are now making more money at 90 cents and doing the work absolutely as well. We are treating our best equipment in that way and doing it with a 5-in. brush, and the work has to be first-class, as we would not accept any other.

T. J. Hutchinson (G. T.): When I first went to Ontario we used the 3-in. camel's-hair brush for color coats, but I found that the hair was not long enough and we soon had a lot of stubs accumulated. We now use a longer-haired brush called an ox-hair brush. The hair is fully one-third longer than the civit hair brush or the camel's-hair brush. If I were working piecework below the windows I can understand how I could use a 5-in. civit hair brush, but above the windows you would have to use another brush. We work piecework, and so far have been able to get over the cars in a reasonably short time, so that the pieceworkers make a good premium with a 3 and 3½-in. ox-hair color brush. The hair is much longer and they are able to spread it quicker, because the pressure does not crowd the color out of the brush as it does with a shorter-haired brush, as it does not leak.

J. W. Gibbons (A. T. & S. F.): The proper brushes depend to a great extent on the kind of surfacing and paints that you are using. For instance, if you have a mineral with linseed and turpentine, the brush does not have to be very stiff to crary the color. If you have some strong, heavy surfaces, I think you require a half elastic brush, stiffer and stronger, and in the same line as a varnish brush, but not as good. The proposition also depends upon the men. We use today a 4-in. Gem brush for our primer, which is a heavy surfacer. The varnish brush is a 6-0 thumb, long hair. We have the bonus system on our road. 67½ per cent. efficiency is a day's work, and all over that they get a bonus for. We have men applying surfaces and varnishes that run from 125 to 180 per cent. efficiency. I believe that particularly in flat colors a large brush that will carry the material and flow it on evenly will cover the surface and do away with the laps.

Mr. Dane: On the tenders, cabs and top work we use a flat color and then we varnish afterwards. In applying that flat color, my men have selected a brush that I would call a No. 4-0 varnish brush, stiff, instead of the flat camel's-hair or anything of that sort. They work by the day. They seem to think they can apply that flat color better with that brush than they can with a flat brush. It is a question whether that brush applies flat color better than a flat brush or camel's-hair or soft hair.

E. E. Lewis (Penna.): Our men prefer the round 8-0 brush for applying engine finish with flat color. We use flat brushes for primers and surfacers. For varnish we use a 6-0 varnish brush, either black or white bristle. We get good results and the men seem to be satisfied. They work piecework and, of course, that has a tendency to enlarge the sizes of the brushes and tools. We have not increased the size of the brushes at all except flat brushes for priming. They seem to be very well satisfied; they get good results and good rates using the round brushes. Just a short time ago we had some sample flat brushes sent to us, but the men preferred the round brushes.

SAFETY FIRST

J. H. Pitard (M. & O.): The safety first movement which was recently launched by the railroad companies for the purpose of safeguarding the lives of their employees and the traveling public, is an act of benevolence that deserves the hearty co-operation of all departments of railroad operation to insure its success. The accidents in the paint department are perhaps too infrequent to be seriously considered and the principal question is the preventing of occupational diseases. Even these, however, are very few. They owe their origin to three principal sources: Hygienic shop conditions, unwholesome paint materials and the habits of the workmen.

There is nothing mysterious about shop hygiene; it simply means good sanitation, ventilating, and heating a shop in such a manner as will permit of the free escape of impure air and noxious gases and the admission of pure air. Failing to do this will lower the vitality of the workmen and correspondingly decrease their efficiency. Good ventilation is especially essential in a paint shop, due to the fine particles of lead dust, fumes from the paint materials and the necessarily heated condition of the shop.

With a few exceptions all paint materials are more or less unwholesome, the chief offender being white lead, which is liable to cause lead poisoning or "painter's colic." Wood alcohol, bi-sulphide of carbon, benzole, turpentine substitutes of various kinds and some other chemicals are unwholesome on account of their rapid volatile properties, their fumes permeating the shop. Such materials should be labeled, calling attention to their inherent dangers. It is possible to eliminate these detrimental odors by only using freely mixed paints and by keeping all paint stock in air-tight containers. The stock rooms should be especially well ventilated.

All employees should be compelled to keep themselves clean and should have clean overalls every week. They should not be allowed to eat meals in the paint shop and the use of intoxicants and cigarettes at any time should be discouraged.

C. A. Cook (P. B. & W.): The solving of the problem of safeguarding ourselves and others, lies entirely within our own province, and can only be solved by the elimination of the element of carelessness so universally prominent and the development of our powers of observation. Safety appliances and rules avail themselves of no value if we allow ourselves to be careless, indifferent and disinterested in their use and observance. It has been said that 80 to 90 per cent. of injuries to railroad employees are due to their carelessness. The preservation of the health of the workman is of vital importance to the corporation that employs him and the deterioration of his vitality impairs commensurately his productiveness. The results of investigations and tests of the paint materials used in the paint shop should be carefully studied and considered when handling them in order to guard against any possibility of injury from them.

E. F. Bigelow (N. Y. C.): The absence of machinery in the paint shop does not permit a great deal to be done in the matter of safety devices, but nevertheless danger may be present and may also be overcome in a great degree. Probably the most accidents which occur in paint shops result from the use of the old style plank and horse staging, their imperfect construction and recklessness on the part of the workmen while using it. The practice of using a horse with legs of unequal lengths or having broken cleats is quite common, and with a warped or twisted plank form a very dangerous combination. A large number of accidents have occurred from this source, all of which were preventable had ordinary care been used.

Ladders used in shops having concrete floors should be equipped with movable basswood shoes, or some similar appliance, to prevent slipping. Lying face downward on car roofs to paint decks or clean deck glass is a common and very dangerous practice. In some shops this is now a dischargeable offense. Bad places in flooring, the occasional piece of wood with projecting nails lying on the floor, are fruitful of sprained backs and ankles and blood poisoning, all of which may be reduced to a minimum by prompt repairs and a clear shop.

As regarding occupational diseases in the railway paint shop, I must confess to utter ignorance, for in twenty-eight years' experience and asociation with several hundred men in different localities during that time, I have yet to find the man suffering from any disease resulting from his occupation as a railway car or locomotive painter. The commission of labor of the state of New York has recently issued orders requiring that a place outside the paint shop be provided in which the painters may eat their lunches. Food or drink is not permitted to be brought in the paint shop.

DISCUSSION.

The consensus of opinion seemed to be that a paint shop should be well ventilated, especially in rooms where volatile, injurious liquids were being used, so that any of the fumes being breathed by the workmen may not have a harmful effect. The greatest number of accidents in the paint shop appears to have been caused by injuries due to carelessness rather than occupational diseases, but it was suggested that the painters should be informed as to the injuries that might result from handling the various paint materials, and instructed as to how to protect themselves from injury. As regards the question of using the paint sprayer apparatus, it was pointed out that if the men were properly provided with a regular respirator, the same as they use around lead works, no trouble would be experienced. It was acknowledged that to try and spray a lead or turpentine vehicle was more or less dangerous. G. Swing, of the Pullman Company, mentioned that every painter employed by that company is subjected to a physical examination and is then given clean overalls, jacket and nail brush by the Safety Department. He is allowed ten minutes before closing time to change his overalls, clean his hands and finger nails, brush his teeth and wash. Once a week each man is allowed half an hour in which he is compelled to take a bath. During that time he is under the jurisdiction of the Safety Department. The company furnishes all the overalls, etc., and they are sent to the laundry and washed each week. A doctor examines every man in the paint department once a month for lead poisoning, and advises if the work the man is doing is injuring him in any way. A separate dining room is maintained outside of the paint shop for the men to eat their lunches.

A resolution was submitted by C. A. Copp, of the Boston & Maine, to make a Safety First slogan of the association, and to watch at all times to render the shop a safe place for employment.

PAINT PROTECTION FOR STEEL EQUIPMENT

J. F. Lanfersick (Penna.): No matter how well this kind of equipment is painted there are some other things that should be given consideration by the officials. I refer to the loading of coal cars with hot billets, slag, cinders, ashes or any other hot substances, also the striking of the sides of the cars with hammers and wrenches to start the load to fall out. If these practices are allowed to continue, it is useless to bother much about the painting of this class of equipment, as they soon put the paint to the bad. The inside of the cars is not given the same attention in the way of painting as the outside. In most cases the interior does not receive any paint whatever. Before assembling the parts used in the construction of new steel equipment, all of them should be sandblasted on the exterior and given one coat of good linseed oil paint as quickly as possible after the sandblasting is completed. After the cars are constructed the outside and underneath parts should be given two additional coats of good linseed oil paint, leaving twenty-four hours between coats. After the last coat is dry the necessary stenciling should be done. This method will insure the paint rendering from four to six years' service without repainting.

When this class of equipment is sent to the shop for repainting, all rust and foreign matter should be removed with the steel scraper and wire brushes from the parts outside and underneath the cars. After the cars have been cleaned, the parts outside and underneath, if necessary, should receive two coats of good linseed oil paint, leaving twenty-four hours between coats. After the last coat is dry the necessary stenciling should be done. As to interiors of coal carrying cars, I do not think it would pay to paint them. When refrigerator cars have steel ends, those parts on the interior of the cars should have at least one coat of paint to protect them from dampness. All steel roofs and other parts of steel equipment should have the exposed steel parts painted with at least one coat of paint.

F. A. Weiss (C. of N. J.): Our steel freight equipment consists mostly of hopper coal cars and freight gondolas; the former cars are used in handling anthracite coal, which is particularly hard service. The first requisite is to remove the rust and place the surface of the steel in proper condition to receive its protective coating of paint; experience has taught us that the sandblast is not only the cheapest, but the most effective way to do this.

Our plant consists of a blasting shop, of two cars' capacity, 90 ft. long by 28 ft. high, flooded with light because the sides are practically all glass above a height of 5 ft. and amply ventilated. At a distance of 300 ft., and so arranged that the cars when cleaned may be run directly into it, is the paint shop, which is used more particularly in rainy weather, on clear days the work of painting being usually done outdoors. I may say here that all our steel freight car painting is done by the paint spraying machine. Air is piped through the yard at a pressure of 95 lbs. per sq. in., with outlets at all points where the painting is done. The sand we use is sea sand. The men engaged in this work are provided by the company with proper protection to prevent them from inhaling the sand, and thereby possibly injuring their health.

The cars are painted immediately after the blasting is done, to protect them from moisture that may settle on them. After twenty-four hours the sides and ends of the bodies are given the second coat of paint, and on the third they are stenciled and released for service, the trucks receiving but one coat.

The paint we use and find to be durable is carbon black, reduced with raw linseed oil and one of the prepared extending oils, the proportions of which are determined by the quality of the extending oil.

Provided the question of time in getting the equipment through the shop was not so urgent as it is on most railroads, and also where cost is not considered such an essential element in the problem as it is generally regarded by the railroad management, the exterior surface of the car should be sandblasted and primed with red lead mixed with raw linseed oil, and finished with two coats of carbon black, carrying the maximum quantity of raw linseed oil to which is added a portion of extending oil. The last coat need be applied only to the sides and ends of the body. On new cars laps and joints should be given a heavy coat of red lead or carbon black before the car is assembled. Trucks which are repainted require but one coat, while new trucks should have two, carbon black being a suitable material for the purpose.

Oscar P. Wilkins (N. & W.): We have been, and expect to continue the practice of testing out every promising material offered for the protection of steel, but up to the present time we have not found anything that will equal pure red lead and linseed oil as a primer, with two finishing coats of carbon black. A steel car surface carefully cleaned with a wire brush, scrapers, benzine and waste, primed with a freshly mixed pure red lead and linseed oil, and finished with two coats of good high grade carbon black, carrying maximum quantity of linseed oil, will give maximum wear with no increase in cost. We have been building steel cars at the Roanoke shop for several years and find fully 99 per cent. of the steel is free from corrosion, which renders it unnecessary to use the sandblast. As for the scale, I believe red lead is an inhibitor of rust, and if there is any rust under the scale the red lead, if not completely arresting its action, certainly retards it. We see this in evidence every day on steel cars that have been in constant service for eight or ten years with nothing but the initial painting, and aside from the hammer blows for loosening up the contents at certain points are in excellent condition.

I realize in taking this position regarding the sandblast that the field is against me, but I can't see the necessity of using a sandblast on steel freight equipment. In order to secure the very best results from red lead priming it must be mixed on the job. In other words, prepare sufficient red lead paste today to be thinned down and used tomorrow. By making the lead and linseed oil up in paste form and allowing it to stand for about twelve hours it permits the particles of lead to become thoroughly saturated with oil, and when it is thinned down and spread on the surface of the car it does not draw from the new oil added, but merely assists in oxidizing the film. I never use lead priming after it has stood in the package for as much as 72 hours, on account of a certain action taking place within that time that should take place on the surface of the car.

ENAMELED INTERIOR TRIMMINGS

John D. Wright (B. & O.): It is a well known fact that nearly all of the interior metal trimmings, lamps, parcel racks, etc., applied in passenger cars in recent years have been made of brass, and more thought seems to have been given to their design, and to the coloring of the metal, than to their cost. In other words, they have been considered more from an artistic than an economical standpoint.

The railroad companies are today confronted with conditions that force economy in many of the smaller details, some of which, perhaps, have been overlooked in the past; and while the metal used on the interior of passenger cars may appear to be a trivial matter, in the aggregate it amounts to thousands of dollars. During the past year this point has been taken up by certain companies and it now looks as if some of the interior brass work will, sooner or later, give way to cheaper metals, and the baking enamel proposition makes this possible. Where the baked enamel finish is used many of the parts which are now removed every time a car is shopped for repairs could be cleaned with the interior of the car, without being removed and replaced. This expense would then be saved, to say nothing of the additional cost connected with the polishing, sandblasting, dipping, coloring and lacquering of brass work.

Another argument in favor of the enameled metal is the improved appearance of a car interior when trimmings are used that are enameled in colors to match the part of the car on which they are placed; the lamps being the same color as the head lining and the parcel racks, locks, lifts and other trimmings to match the body of the car.

There is a possibility, however, of greatly injuring the appearance of these parts if the enamel chips, or wears off, particularly when dark enamels have been applied over brass, or other light metals. This trouble may be overcome, however, to a certain extent, by the use of iron and steel, which holds the enamel much better than brass.

MAINTENANCE OF PASSENGER CARS

T. J. Hutchinson (Grand Trunk): Maximum paint protection is a necessity in railway service and whenever these seven-day systems are introduced and hurried methods of cleaning continued at terminal points, we may look for future trouble that may be called paint failures.

When making out schedules of paint operation it must be remembered that the exterior protection lies chiefly in the varnish, and whenever the service exceeds the life of the varnish it will be at the expense of the whole paint structure, which means extra time and material.

On the steel or wood-sheathed car after the primary coat I believe it will prove economical to apply not less than three coats of surfacing material where the old surfacing systems are followed. I believe that the present-day hurried method of cleaning and caring for the interior of the car en route and at the terminal point is false economy.

RAILWAY PAINT SHOP SUPPLIES

H. Heffelfinger (Penna.): The best materials obtainable for painting and varnishing passenger cars and locomotives brings about the most economical results. The different localities through which the equipment is to run should determine to some extent the material to be purchased and in order to insure the correct material being secured the master painter should be consulted, he in turn being thoroughly familiar with the goods on the market. It is useless to expect good results when inferior paints and varnishes are used, and every master painter of this association should endeavor to make a reputation for doing good work and should do all that lies in his power to impress on his superior officers that he cannot attain the best efficiency in painting passenger equipment and locomotives without their aid in procuring the best and most lasting materials.

OTHER BUSINESS.

W. O. Quest (P. & L. E.) presented an interesting paper on the art of staining woods in which he described the methods and stains used in producing the various beautiful samples he had on exhibition.

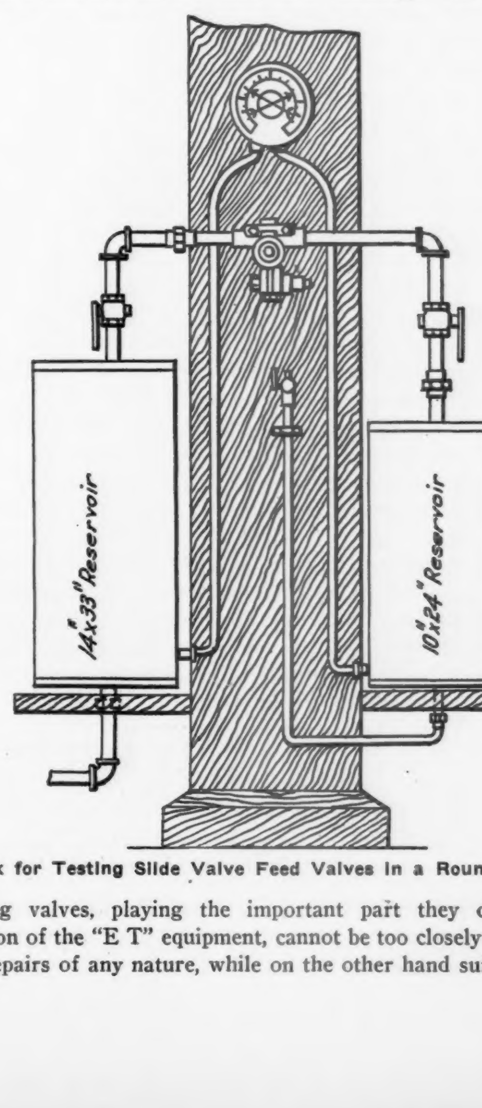
F. W. Brazier, superintendent rolling stock (N. Y. C.), in a letter to H. M. Butts, master painter of the New York Central at West Albany, N. Y., conveyed his regrets at not being able to attend the convention. He called attention to the importance of the steel car question as regards the best method of treating and preserving the steel. This problem is still in its infancy and the members by their discussions and exchange of ideas are in a position to greatly advance the art. He congratulated the convention on the interesting and pertinent subjects that were considered.

At the opening session T. J. Hutchinson, master painter of the Grand Trunk at London, Ont., presented the association with a beautiful banner painted by himself embodying the emblems of the United States and Canada. The following officers were elected for the ensuing year: President, Oscar P. Wilkins, Norfolk & Western; first vice-president, T. J. Hutchinson, Grand Trunk; second vice-president, H. Hengevelt, Atlantic Coast Line, and secretary-treasurer, for the tenth consecutive year, A. P. Dane, Boston & Maine, Reading, Mass. Nashville, Tenn., received the greatest number of votes for the next place of meeting.

ROUNDHOUSE POST RACK FOR TESTING SLIDE VALVE FEED VALVES

BY F. W. BENTLEY, JR.,
Machinist, Butler Shops, Chicago & North Western, Milwaukee, Wis.

In a great many instances where slide valve feed valves or reducing valves become defective at roundhouse points some distance from general or division shops, there is no provision made for a fair test of the valve after cleaning. The feed and



Rack for Testing Slide Valve Feed Valves in a Roundhouse.

reducing valves, playing the important part they do in the operation of the "E T" equipment, cannot be too closely examined after repairs of any nature, while on the other hand suitable provisions for their testing can eliminate the unnecessary return of many of the doubtful valves to the shop when but trifling repairs are necessary to put them at once back into service. The illustration shows an inexpensive feed valve test rack for outside roundhouse points which necessitates no bench or table arrangement as the parts are built up around one of the large roof posts of the roundhouse. The two reservoirs are generally available from material taken from scrapped locomotives, as are also the gage, cut-outs and pipe fittings. With this device it is possible to make every necessary test of the valve's operation to be certain of a satisfactory condition before applying it to the locomotive.

INSTALLATION AND MAINTENANCE OF ELECTRIC HEADLIGHT EQUIPMENT*

BY V. T. KROPIDLOWSKI

III.

It is not possible in an article of this kind to go deeply into the theory of electricity and dynamo-electric machinery, nor is it intended to treat even remotely of electrical designing, but some elementary explanations and illustrations are considered necessary. Those that care to go deeper into the subject will find a number of good books in almost any library treating fully on every phase of the subject.

Figs. 1 and 2 represent an elementary dynamo-electric machine; it will be noted that if the armature revolves in the direction of the large arrow, and if the brushes are connected through an external circuit so as to provide a path for the current, there will be an electromotive force induced in the coil which will cause a current to flow in it in the direction indicated by the small arrow. The two segments of the commutator are represented by *a* and *b*. The commutator serves the purpose which its name implies; it commutes or changes the current, which is alternating in direction twice in every revolution, to a direct current as follows: When the side *A* of the coil in Fig. 1 is passing the *S* pole face the other side *B* is passing the *N* pole face, the brush +, is in contact with segment *a* and the brush —, with segment *b;* the current flows from the side *A* into segment *a* and out to the circuit, returning through brush —, and segment *b* to the side *B* of the coil. In the side *B* it flows toward the back of the armature, upward across the back and again through *A* to the circuit. When the armature has turned far enough so that the side *B* of the coil is passing the *S* pole, as in Fig. 2, segment *b* will have also turned far enough to make contact with brush +, and the current will again flow out to the circuit through the same brush, and so on, as long as the armature is revolving in that direction and none of the connections are changed. In the elementary armature but one coil is shown, but in an actual armature a great number of coils and several turns per coil are necessary in order to generate the required voltage. In the case of a headlight generator there usually are in the neighborhood of 240 inductors (wires that cut lines of force) depending, of course, on the speed and strength of the field. Selecting, for example, a drum armature like the one in the elementary machine, with 20 coils and six convolutions to each coil, there will be (in the drum armature both sides of the coil are on the surface of the armature core) 240 wires distributed over the surface of the core. If the armature makes 2,800 revolutions per minute, or 46 revolutions per second, each wire cuts the flux twice per second, making a total of 92 times. In a wire cutting lines of force at the rate of 100,000,000 per second an electromotive force of one volt is induced, and if we wish to generate 37 volts we must provide ampere turns enough to force through the magnetic circuit

$$\frac{37 \times 60 \times 100{,}000{,}000}{2 \times 2{,}800 \times 120} = 330{,}351$$

lines of force. The ampere turns, that is, the number of convolutions of wire around the iron forming the magnetic circuit, depend entirely on the kind of iron or steel, its quality and the way it is assembled to make up the magnetic circuit, the size of the air gap, etc. This is shown in Fig. 8, where the vertical figures represent the kilolines (number of lines of force divided by 1,000) per square inch of the iron, steel or air gap that will be produced by the ampere turns, as represented by the horizontal figures. The top horizontal figures are those for metal, and the bottom ones those for air.

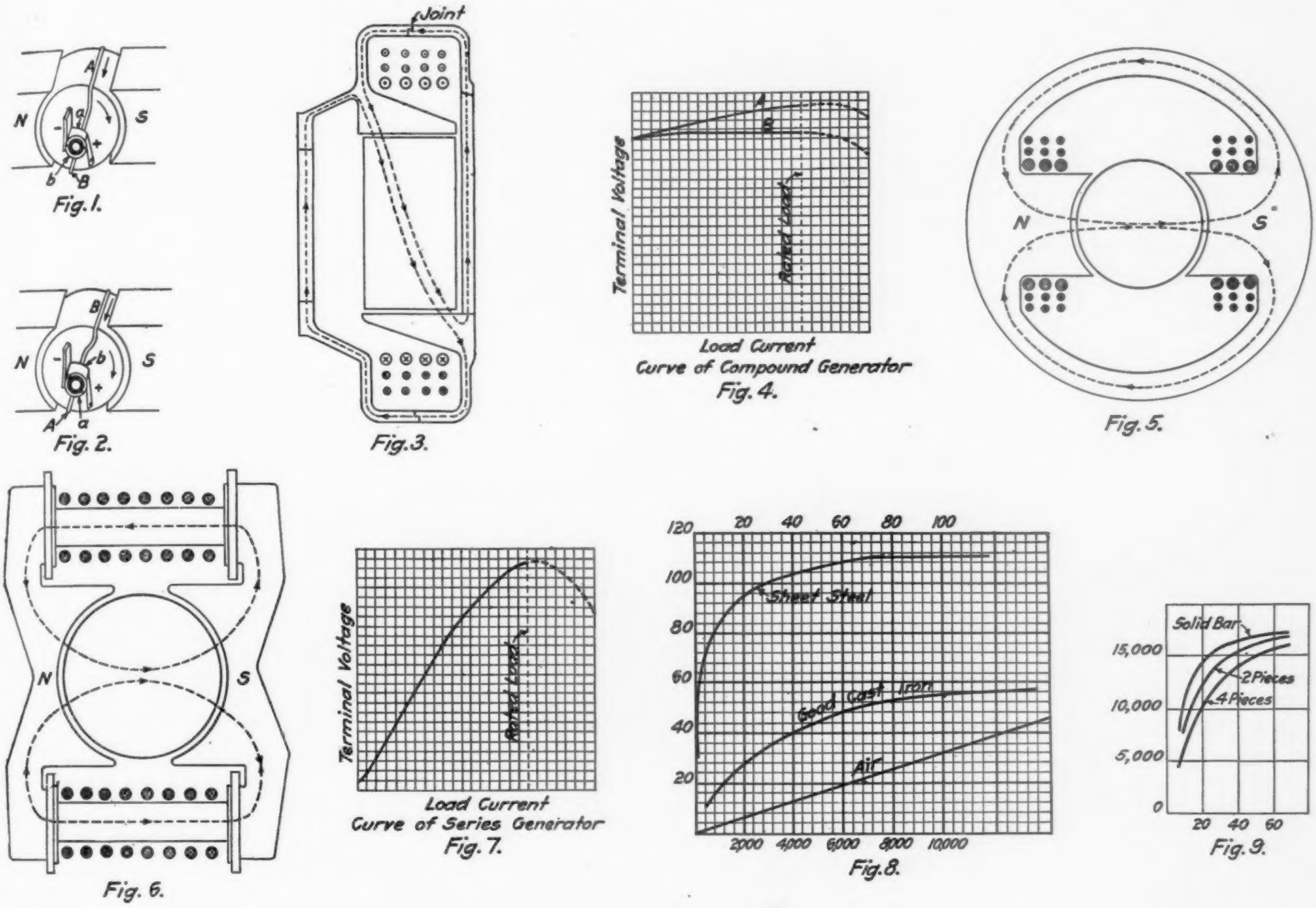
Figs. 3, 5 and 6 represent the field coils and magnetic circuits, and Figs. 10, 11 and 12, diagrammatically, the field winding connections of the types of dynamos in present use for electric headlights. The dotted lines and the arrows represent the path and direction of the magnetic lines of force and the circles the sections of the wires composing the field coils. If Fig. 3 is studied carefully it will be seen that due to its construction it is not as efficient, from the magnetic and electric standpoint, as Figs. 5 and 6, and of these latter, Fig. 5 is the more efficient. It will be noted that some of the lines of force in Fig. 3 must force their way into the armature core through an additional air gap as well as the air gap between the armature and pole pieces and, as a consequence, more ampere turns are required, as may be seen by again referring to Fig. 8. There is also more leakage, or lines of force going astray and not cut by the armature wires, due to this air gap. The lines of force will also tend to crowd toward the neck of the pole pieces where the gap is the least, and if the designer has not allowed for this the iron will become over-saturated and in an over-saturated magnetic circuit the lines of force do not increase nearly in proportion to the ampere turns, or the current passing through the field winding. Furthermore, the armature inductors in that kind of a field will cut the lines of force diagonally and they are not then as effective in inducing an electromotive force as when they are cut directly at right angles. All this requires more wire in the field, and greater speed of the armature, in either case requiring more power, and as a result, more steam. Of course, this may be all offset in other good features of the completed machine, as for instance, in lower maintenance cost, etc.

It will be noted that in Figs. 3 and 6 the frames are in two pieces. Ewing tried the effect of joints in the iron of a magnetic circuit, and Fig. 9 gives the results of his investigation. Reading vertically, the figures represent lines of force, and horizontally, ampere turns required to produce the lines of force. It requires considerably more ampere turns to produce the same number of lines of force through a circuit containing a joint than it does in the case of a solid bar. An ordinary joint is equivalent to an air gap of about .002 in., and it will therefore be seen that Fig. 5 is the most efficient from a magnetic standpoint. The magnetic circuit of Fig. 3 is rather difficult to understand, but if Fig. 14 is referred to it is easier to grasp. The two arrows along the coil of wire represent the current, and the dotted circles the lines of force which the current produces.

There are mainly three types of field windings in general use, the shunt, the series and the compound wound dynamo. Only the latter two are used in headlight service. Figs. 10 and 11 are compound and Fig. 12 is series wound. Fig. 10 shows the way the Pyle generator is connected. One terminal of the shunt field and one terminal of the series field are connected at *d*, and

*It has come to the attention of the author of these articles that there are some readers who believe that if the plan of wiring described in the *Railway Age Gazette, Mechanical Edition,* July, 1913, page 367, is followed, the incandescent lamp in front of the reflector will burn continually. No such trouble need be feared. This can be shown by reference to the fundamental rule of derived circuits. The use of this rule shows that there is available an e. m. f. of approximately 0.02 volts and the resistances for the current to choose in order to reach the negative brush are 30 ohms in the lamp and about 0.02 ohms in the wire. One can thus readily see which path the current will choose. For those not familiar with this rule an actual test is advised. Theoretically there is a small current flowing through the lamp, but from the practical standpoint there is none. This loss of current exists in all commercial installations, but there is not sufficient current to light the lamp.

the terminal of the series coil is left longer and connected to the positive brush holder at *No. 2*. The other terminal of the series coil is brought out and connected to binding post No. 1, which is on the negative brush holder, but insulated from it. The other terminal of the shunt coil is also brought out and connected, metallically, to the negative brush bolder at *No. 3*. The current's path is from the positive brush to connection *No. 2*, thence to the junction *d*, from where the main current circulates through the series field and comes to binding post *No. 1*; the binding post being insulated from the negative brush holder, the current enters the external circuit, performs its work and returns to the armature by way of binding post *No. 4*, and the



Diagrams Showing the Path of Electric Current Through Different Generators.

negative brush holder and brush to the negative side of the armature winding, as in the case of the elementary dynamo. The shunt winding admits but a very small portion of the main current but, nevertheless, supplies the main part of the excitation; this is due to the fact that it has very many turns of fine wire in proportion to the series field and as the field strength depends on the ampere turns, that is, the current times the number of convolutions in the field winding, it is evident that even though nearly all the current goes through the compound field (it having but just enough turns to compensate for the drop of voltage in the armature and external circuit wires due to the full load current) the result from multiplying the current by the number of turns does not nearly equal that of the shunt field. The reason that as much current does not flow through the shunt field as through the series field, when both have the same metallic connection, is that the former has greater resistance due to the use of very fine wire with greater number of turns. It also seems, in the case of a series machine, where very nearly full load current must be passed through the series field when but two or three incandescent lamps are burning, that there must exist a lot of waste of current; this is not the case, as the number of watts lost in the field depends on the square of the current times the resistance. The series field has a very low resistance and the shunt a high resistance; for example, if the shunt field has 25 ohms resistance and a current of 1.2 amperes flows through it the loss is 1.2 x 1.2 x 25 = 36 watts, and if a series field has a resistance of .04 ohms and a current of 30 amperes passes through it the loss equals 30 x 30 x .04 = 36 watts, the same as in the previous case.

Fig. 11 shows the way the Schroeder generator is connected. The first two terminals of the shunt and the series fields are connected to each other and to the positive brush, the same as in the Pyle machine, *e* being the common junction of the two fields and *No. 5* the connection to the positive brush holder. The other terminals of the fields are brought out, the series connected to screw *No. 6* and the shunt to the negative brush holder at *No. 8*. The current's path is from the positive brush to connection *No. 5*, to junction *e*, a small part of it going through the shunt field to the negative brush at connection *No. 8*, and the main current through the series field to connections *No. 6* and *No. 12*, which are metallically connected; from there it passes through the external circuit, doing its work, and returning to the negative brush by way of connections *No. 13* and *No. 7* and brush holder connection *No. 8*.

Fig. 12 shows the connections of the American headlight generator, which is a series machine. This machine, instead of having a large number of turns of fine wire on its field pieces, has comparatively few turns of larger size wire, through which all the current passes. The path of the current in this machine is from the positive brush to connection *No. 10*, thence to the external circuit, doing its work and returning to the negative brush by way of binding post *No. 9*, the series field and positive brush holder connection *No. 11* and through the negative brush into the negative side of the armature.

Fig. 4 represents the external characteristic curve of a compound generator, that is, it shows the voltage in relation to the current. The curve *A* is that of an over-compounded generator, and curve *B* of a flat-compounded machine, or one in which the voltage is maintained practically constant. It will be seen that in a compound generator the voltage is at its maximum whether the generator is supplying no current or full load current; after the capacity of the machine is reached it begins to fall quite rapidly, this being due to the iron composing the magnetic circuit becoming over-saturated with lines of force. Fig. 7 represents the voltage curve of a series generator, and it is seen that at no load there is very little voltage, only that which the residual magnetism is able to create. The reason for this is that when no current is delivered to the outside circuit there also passes no current through the field; but the voltage increases rapidly with the load until the capacity of the machine is reached, when it again begins to drop, due to the reason given above. The expression "up to capacity" is, in this instance, not strictly true, as the capacity of the winding may be reached and yet the magnetic circuit might be so designed that its saturation point has not been reached, in which case the voltage will continue rising until ultimately it may destroy the insulation of the winding, due to overheating from excessive current. For this very reason the designer proportions the sectional area of the magnetic circuit so that when the capacity of the winding is reached, or even before it is reached, the iron becomes saturated, thereby offering greater resistance to the lines of force and consequently less lines of force circulate in proportion to the exciting current; as a result the voltage begins to fall rapidly.

A considerable number of headlight failures and delays to locomotives could be avoided if proper inspection was followed out in the roundhouse, and there is included here a description of a method of testing armatures and fields for defects. An ammeter reading to 30 amperes and three dry cells are required. The ammeter shown in Fig. 13 is a small instrument, but a higher grade instrument is more reliable. The cells should be connected in series with copper strips of about 1/32 in. x 3/8 in., and the connecting wires should be as large in diameter and as short as conditions will permit, so as to have as little resistance as possible, as cells have very low voltage and if connected through even quite low resistance the current, and consequently the reading, will be low, making the easy determination of faults difficult. To illustrate, supposing the three cells to have a voltage of 2 volts each and a resistance of 0.10 ohms each, if we short circuit them on themselves we will get a current of $\frac{2 \times 3}{0.10 \times 3} = 20$ amperes, but if we connect them through something that has, for instance, 2.7 ohms resistance, we will get a current of only $\frac{2 \times 3}{0.10 \times 3 + 2.7} = 2$ amperes.

ARMATURE TROUBLE.

An armature should run without heating excessively; if it heats to any great extent and the machine does not carry an overload it may be due to several reasons. The armature may be damp, thus materially weakening the insulation, in which case it should be taken out and baked. This fault can be determined with a high reading volt meter, but this will not be taken up now as it belongs more to shop repairs, which will be treated later.

If a generator sparks badly or fails to generate at all, an open circuit invariably exists somewhere. To look for it in the armature, take out the brushes and apply the testing device as shown in Fig. 13. The two contacts *b* should be of ample size and of copper, each of a width to not quite cover one segment. They should be placed on two adjacent segments and arranged so as not to touch. By moving them around the commutator step by step, a practically uniform reading will be obtained until the segment to which the broken or unsoldered connection belongs is reached as at *a*, Fig. 13, when there will be a very low reading due to the current having to pass through the entire armature winding. Temporary repairs can be made on this broken coil by entirely disconnecting it and short circuiting the two segments to which it was connected by dropping some solder on them to bridge them over the mica.

Sometimes an open circuit will not show when the machine is standing still, as the conditions may be such that centrifugal force separates the broken wires or connection, but when the machine comes to rest the broken wires may come together enough to allow considerable current to flow. In such a case, when the generator is again started it should be watched very carefully, to see if by short circuiting the brushes with some piece of metal a spark is obtained when it is starting up; if a spark is obtained when starting and not after the machine speeds up, there exists an open circuit, and the armature should be replaced and sent to the shop for repairs. Of course, in this case it is assumed that nothing is wrong with the field.

If a short circuit exists in an armature it will heat and will be hottest where the short circuited coil is. In testing for a short circuit apply the tester as before, when a uniform reading will again be shown until the short circuited coil is reached, when a heavy reading will result. To repair this temporarily either remove the coil entirely and bridge the two segments with solder as in the previous case, or cut every convolution of the coil and tape the ends so as to prevent them from coming together metal to metal.

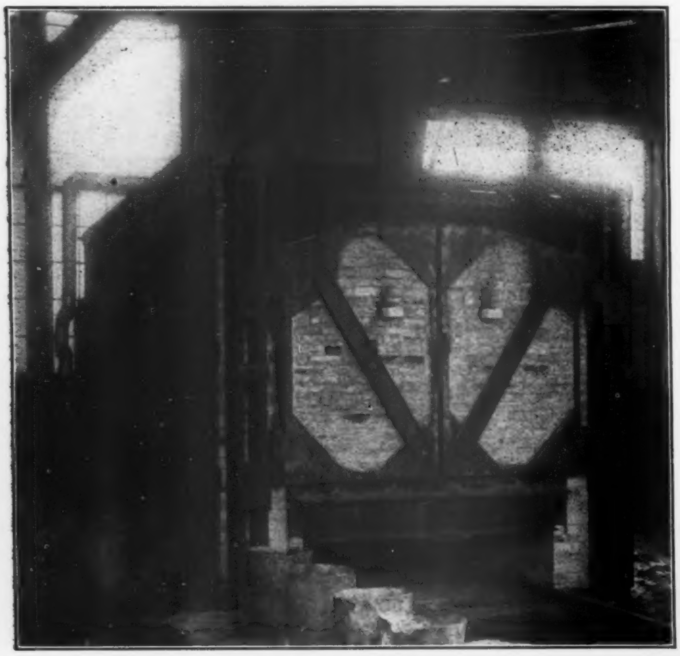
In testing the field for troubles the method is as follows, referring to Fig. 11. It is well to test one of each of the different makes of generators, to determine the resistance of the fields when they are in good condition, and put the readings of the meter in a note book, so that in testing later for faults it can be determined whether the resistance is high or low compared with that of a machine in good condition. The shunt field has a high resistance, and if the instrument and battery are connected in series with it there will be a very slight deflection from which little can be learned; the testing set is therefore connected in parallel, as shown by the dotted lines. Connect one side of the set to connection *No. 8* as shown by dotted lines *h* and *k*, and the other side to *No. 5*, and connect the battery *j* across the two wires at *F* and *W*; the brushes should be lifted when doing this. If the meter shows about the same reading as that in the note book for that make of machine the shunt field is in good condition, but if it shows a much lower reading the field is short circuited somewhere and must be replaced. If the meter shows a very high reading, an open circuit exists in the field; to make sure of an open circuit, connect the testing set in series with the field by disconnecting the battery at *F* and connecting it at *u*, as shown by the solid line, and disconnect wire *k* either at *w* or *u*; if no deflection is evidenced there is an opening somewhere in the field. The series field can be tested with the testing set in series, and to put it in series with the series field, leave the connections of the battery and the meter as in testing the shunt field in the second case, but change the dotted line *h* from connection *No. 8* to *No. 6* If there is a reading closely approximating the record in the note book for that make of machine the field is good, but if the reading is much higher the series field is short circuited. The generator will generate full voltage even though the series is short circuited, but the voltage, when the arc lamp is switched on, will drop considerably and will cause the arc lamp to jump, due to the solenoid not being able to lift the upper carbon sufficiently. The only remedy in case of a short circuited series field is to replace the entire field, as in the case of a shunt field; of course both fields must be removed, as they are in one coil. If no deflection occurs it is a sure sign that a connection is loose somewhere in the field circuit.

DELAWARE & HUDSON FOUNDRY

In connection with the new shops at Watervliet, N. Y., the Delaware & Hudson has installed a combination grey iron, brass and steel foundry. The making of even brass and iron castings by railroad companies is believed to be of doubtful economy by many, but in addition to these this foundry is turning out all the steel castings used in locomotive and car repairs except driving wheel centers and locomotive frames. The mechanical department officers of the road have been much pleased with

General Arrangement of the Interior of the Delaware & Hudson Foundry.

the results, particularly in the reduction of the time of delivery of castings. When a casting of any description is needed in a hurry it can be molded and delivered almost immediately, eliminating the delays attendant on ordering and shipping from outside sources. Excellent results have been obtained from the steel



Oil Burner Type Annealing Oven.

castings, including driving boxes, and with the means of making these castings so near at hand, it has been found convenient, in several cases where iron castings have proved of insufficient strength, to replace them at once with steel castings. This often saves delay in getting locomotives out of the shop and if the

Side Blow Stee' Converter of Two Tons Capacity.

casting is unnecessarily heavy it can be redesigned later.

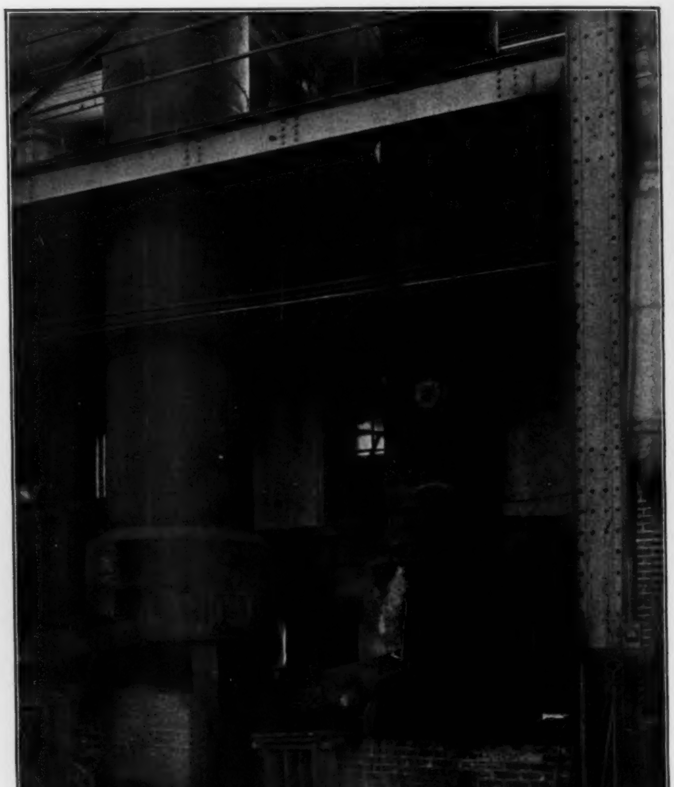
The main bay of the foundry is 57 ft. 4 in. x 176 ft., and is devoted to molding operations. The side bay is 30 ft. x 176 ft., and includes the cupola room, the core room and the cleaning room, and also provides space for the steel converter, sand grinder, sand storage, and annealing oven. The blowers are located on mezzanine floors.

The equipment was furnished by the Whiting Foundry Equipment Company, Harvey, Ill. For the melting department (grey iron and steel) this includes a standard No. 5 Whiting cupola of from seven to nine tons capacity per hour, and a cinder mill; a No. 3 cupola is used for melting stock for the converter.

In the steel foundry there is used a Whiting side-blow converter of two tons capacity, with the tipping mechanism operated by a motor; it is fitted with a Roots high pressure positive blower. There is also an oven 10 ft. x 13 ft. 6 in. for annealing steel castings, and a rotary sand grinder.

The coremaking department is provided with a car oven 7 ft. x 17 ft.; a drying oven for cylinder molds, 12 ft. x 17 ft., and a battery of drawer type ovens in three sections. An electric jib crane of four tons capacity is used for handling the cores. The core and annealing ovens are oil fired. The cleaning department contains three exhaust tumblers 36 in. x 60 in.

The brass foundry included a tilting brass furnace of 400 lbs.



Arrangement of Cupolas in the Delaware & Hudson Foundry.

capacity, but this was found to be insufficient for the needs and it was moved to the erecting shop, where it is used for casting hub liners, a larger one being installed in its place. There are also installed a magnetic separator, a 24 in. x 30 in. wet tumbler, a metal band saw and the necessary benches and grinder. In the general equipment of the plant there is a complete system of industrial tracks and turntables, as well as charging cars for pig iron and coke.

The foundry is under the direct supervision of J. H. Manning, superintendent of motive power, and G. S. Edmonds, superintendent of shops, Delaware & Hudson Company. V. Z. Caracristi was consulting engineer in charge of the construction.

CAR DEPARTMENT

FREIGHT CAR TROUBLES*

BY J. C. FRITTS,
Master Car Builder, Delaware, Lackawanna & Western

The question has been asked as to why we are experiencing so much trouble with freight carrying equipment. In answering this question we must take into consideration the age and design of the cars and also the service they are called on to perform. There are in round numbers about two and one-quarter millions of freight cars in the country, varying in age from one to twenty-five years, and beyond doubt a large number of the older ones are unadapted for present-day train service.

Up to fifteen or sixteen years ago it was the general practice to build cars with short draft timbers extending from the end sill back to and butting against the body bolster. These draft timbers were secured to draft sills (5 in. x 8 in., in some cases 5 in. x 9 in.) with four vertical bolts. I know of some cases where this practice was in use within the last three years. As a protection to the car against shocks it was the practice to use one or two helical springs between the followers for a draft gear. Cars having draft arms and attachments of this type will not stand the strains they are subjected to in the present long trains.

Fig. 1—Older Type Draft Sills and Bolster.

One of the first things I would suggest doing to relieve the present unsatisfactory condition would be to substitute for the present short draft arm one of metal construction that will extend back of the bolster. This would lead to an inspection of such cars by their owners to determine whether any of them would warrant the expenditure necessary to re-enforce them with suitable metal draft arms and the application of a draft gear which would be a non-recoil, shock-absorbing device. Cars which would not warrant such repairs or renewals should be confined to local service, where the owner would be the only one to suffer the consequences of perpetuating such equipment, or they should be destroyed, using the money received from the sale of scrap to apply on the purchase of new equipment. I believe if we were able to keep a record of the amount expended on each car to keep it in service we could easily prove that so much of the total amount used was being spent on a certain lot or class of cars that it would be economical to take them out of service.

The Master Car Builders' Association, at its June meeting this year, discussed at some length the question of withdrawing from interchange service all cars of 40,000 or 50,000 lbs. capacity. The discussion resulted in the following motion by D. F. Crawford:

"I move that a committee of this Association obtain from each of the members a statement of the situation as to each of their cars and ascertain if it would not be possible to make a recommendation to the American Railway Association which will permit us, for the benefit of the traffic conditions of the country, to set aside the older cars which are giving every one of us trouble that are moving them." This motion was carried.† This is a move in the right direction for instant relief, and it behooves us as members of the Central Railway Club to get in touch with this committee, as soon as it is appointed, and render all the assistance in our power. I believe, however, the question is one of draft timbers, draft gear and buffing arrangement more than capacity, or even age. However, should we eliminate the old cars, we still have a large number left that are giving a great deal of trouble in the way of broken draft sills, draft timbers, end sills, couplers, etc., and with such cars it is often hard for the mechanical man to decide the most economical method to follow.

Careful investigation indicates that the stresses due to buffing and pulling have more than doubled in the past ten years so that cars built to meet conditions of ten or twelve years ago are not able to stand present-day service without serious damage to themselves as well as adjacent equipment. It can hardly be expected that the cost of maintenance due to failures will remain constant with the same equipment under such varying conditions of operation.

Fig. 2—One of the Common Failures.

Fig. 1 shows the general construction of the older type of equipment, having wooden body bolsters, short draft arms, separate lug castings and a single spring of 18,000 lbs. capacity to protect the car from shocks, which in many instances exceed 500,000 lbs. It is not an unusual occurrence to apply draft timber bolts to cars of this construction two or three times

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†See *Daily Railway Age Gazette* of June 18, pages 1488-9.

while being handled a distance of from four to five hundred miles, resulting in delays, extra switching in the various yards, and, in many instances, serious interruption to traffic.

One of the very common failures in this class of equipment is illustrated in Fig. 2. It will be noted that the draft timber bolts have been pulled completely through the center sills, which were of sound material and properly applied, the car simply having been subjected to greater stresses than it was possible for it to withstand. Due to the age and construction of this type of car the expense of applying proper re-enforcements would not be justified, and if the cost to maintain the older equipment was kept separate from the newer and stronger cars it could be easily shown that the proper course to pursue would be to destroy them and apply the scrap credit to new cars. There are, however, a large number of cars built at a later date that are subject to frequent failures, partly due, it would seem, to faulty construction.

Fig. 3 shows a type of construction used on many cars less than ten years old; these are equipped with solid metal body bolsters, with short draft arms in connection with double spring gear and even, in some instances, with the single spring gear. This arrangement will not stand the frequent shocks to which freight equipment is subject, especially over mountainous roads where heavy power of the Mallet or Mikado type is used. The draft arms that extend only from the end sill to the body bolster

Fig. 3—Metal Bolster and Short Draft Sills.

should not be used in any case. They are the cause of numerous failures together with resultant interruptions of traffic and should be replaced either by the continuous steel construction or long metal arms in connection with open bolsters, locking them with both the top and bottom members. As before mentioned, the general condition and age of the cars have to be taken into consideration when deciding which method of reconstruction should be used.

Fig. 4 shows the center sills and side sill of a modern steel underframe box car, body of which was completely broken in two, due to a bursted air hose while being handled in a train of forty-two cars. The reason for this failure is very apparent and could have been avoided if the sills had been properly tied together. It is quite common to still see cars built having a center sill construction without cover plates, using diagonal braces from the outer ends of the body bolsters, needle beams and end sills to the center sills to avoid spreading or buckling. It has been demonstrated that this type of construction will not give satisfaction.

Steel center sills buckled within 12 in. back of the body bolsters are shown in Fig. 6. It is thought by some car designers that if steel members are tied together at a distance in proportion to the width of the flange, it is sufficient and will meet all requirements. This practice may be mathematically correct but it does not prove out in service, as this photograph clearly shows.

Another type of steel underframe construction that is giving considerable trouble is shown in Fig. 5. While the center sills have been properly tied and strengthened between the bolsters, one of the most vital points has been overlooked; i. e., the draft arm, made of pressed steel shapes, is riveted to the center sills which have no cover plate, or other means of tying them together, resulting in frequent serious damage and delays to both equipment and lading. The experience of the writer indicates

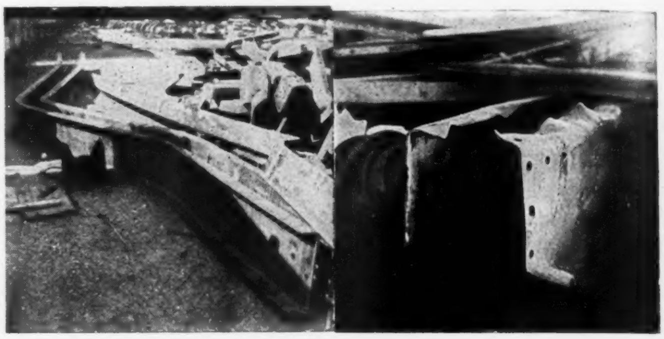


Fig. 4—Weak Center Sills. Fig. 5—Weak Draft Sills.

that riveting the draft arms to the center sills to facilitate repairs does not make as strong a construction as continuous sills. It forces a weak construction to start with, because, in order to make such a connection secure against buffing shocks and pulling stresses, a large number of rivets must be used in making the connection, and the holes for the rivets are sure to weaken the structure; but in either case cover plates should be used. The top one should extend from end sill to end sill and the bottom one as far through the bolsters as possible without interfering with the movement of couplers or draft gears.

A very common failure where the draft arms are riveted to the sills is shown in Fig. 7. The slight saving made in facilitating repairs is offset many times by frequent damages of this nature and the large number of cars failing at this point is conclusive proof that this construction is unsatisfactory.

The photographs, selected from a large number, are typical and show the seat of some of the freight car troubles.

Fig. 6—Failure of Center Sills Due to Poor Design.

The cars shown were not in wrecks or collisions but were damaged in regular service; and all were equipped with one of the various types of spring draft gears which will be considered later.

The photographs also show what we all know to be true, that the part of the car designed to withstand the buffing and pulling stresses is giving more trouble than all the other parts taken together and for this reason must be strengthened. There are two methods used in re-enforcing old equipment.

First, for the older types of cars that we do not feel justified in going to the expense of providing with steel underframes, some roads are using a metal draft arm instead of the old oak timbers. These metal arms are being made of steel castings or standard rolled steel shapes riveted together in such a manner as to prevent the sills from spreading. I have tried both kinds and favor the steel casting for the reason that it withstands greater buffing stresses and can be molded into one piece for each arm, making fewer parts for the repair men to handle; the only extra parts needed are two or three tie plates riveted from arm to arm so as to make them both act together in receiving the shocks. Furthermore, the metal can be molded in any shape, which allows of a distribution to give maximum strength. These arms, starting at the striking plate, should pass back through and over the transom for a distance of at least 24 in. and have square butting ends to receive a good stiff compression timber secured to the under side of the center sill.

One of the latest designs of this type of steel casting draft arm is shown in Fig. 8. The compression timbers should be placed in line between the needle beams and from each needle beam to the butting face of the metal draft arm. They should also be fitted so tightly that a jack is required to get them in place, and they should be of good stiff section, at least 5 in. x 6

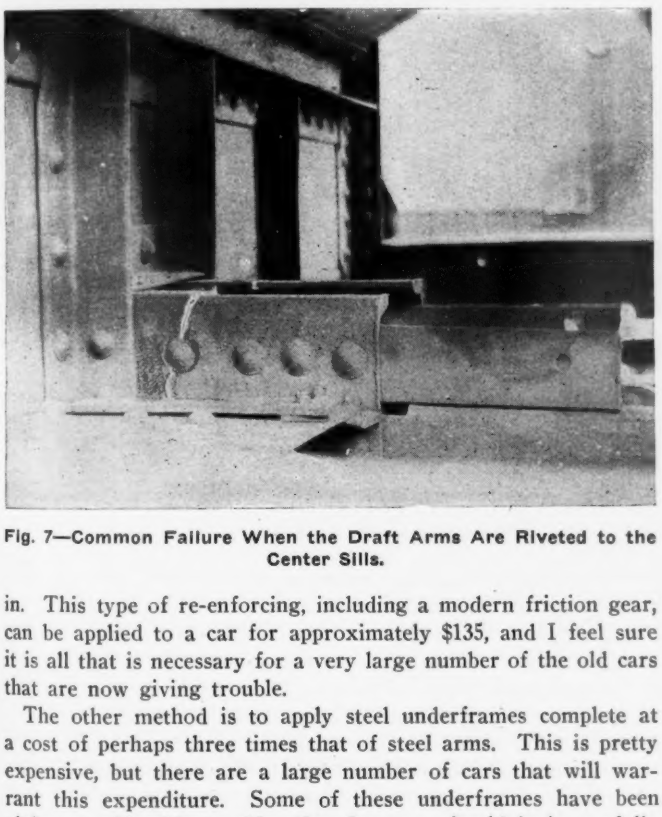
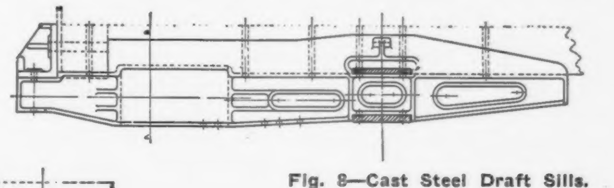


Fig. 7—Common Failure When the Draft Arms Are Riveted to the Center Sills.

in. This type of re-enforcing, including a modern friction gear, can be applied to a car for approximately $135, and I feel sure it is all that is necessary for a very large number of the old cars that are now giving trouble.

The other method is to apply steel underframes complete at a cost of perhaps three times that of steel arms. This is pretty expensive, but there are a large number of cars that will warrant this expenditure. Some of these underframes have been giving considerable trouble; therefore, we should look carefully into these troubles and design future frames with a view of overcoming them.

One of the latest types of steel underframe construction which it is believed has the greatest strength for a given weight is shown in Fig. 9 and Fig. 10. The center sills are continuous and the cover plates extend through the body bolsters as far as the construction will permit. Auxiliary cover plates at the center have been provided, both top and bottom. The body bolsters have been carefully considered. (A few extra pounds of metal at this point will bring good results.) Securely riveted to the center sills is a top plate 20 in. wide, which will throw a great deal of strength into the center column over the center plate, where the failures show we have the most work to do, and also acts as a gusset, strengthening the frame against lateral forces. The back lugs have been extended to the bolster and act as stiffeners for the sills. The area of the cross section at the bolster is between 24 and 25 sq. in., which we believe should be the minimum for a 30-ton car. The center line of the coupler has been placed 1 in. below the neutral axis of the center members, this being a feature which does not seem to have been given proper consideration in the past. By keeping the force thrown against the car near the center of the draft sills, not only the liability of buckling but the breaking down at the bolsters



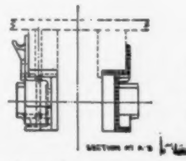


Fig. 8—Cast Steel Draft Sills.

is reduced to a minimum. Car designers should arrange the trucks and underframes so that this can be accomplished.

The underframe having been properly designed and constructed, we must next consider the type of draft gear. Experience from service conditions indicates very strongly that a modern friction gear gives the greatest protection, thus reducing the cost of maintenance and all other expenses incident to car failures. A very careful check of cars placed on shop tracks for repairs, in several parts of the country, shows that an average of 71 per cent. are so placed on account of defects that have developed due to shocks, and of a lot of 1,000 cars recently transferred it was found that over 80 per cent. of the failures were

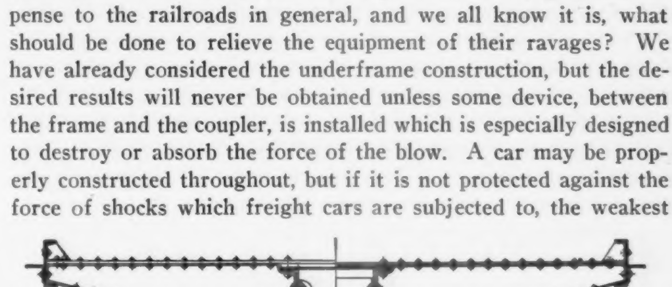


Fig. 9—A Satisfactory Design of Center Sill and Draft Gear Connection.

also due to shocks. Investigation of the cause of damage to lading indicates that a large percentage can be traced to the same cause. If these shocks are responsible for so great an expense to the railroads in general, and we all know it is, what should be done to relieve the equipment of their ravages? We have already considered the underframe construction, but the desired results will never be obtained unless some device, between the frame and the coupler, is installed which is especially designed to destroy or absorb the force of the blow. A car may be properly constructed throughout, but if it is not protected against the force of shocks which freight cars are subjected to, the weakest

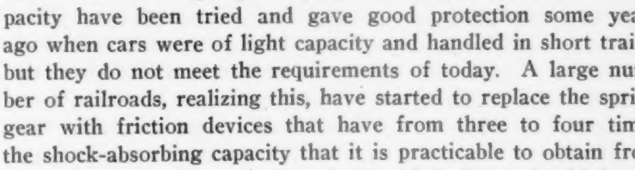


Fig. 10—A Successful Form of Body Bolster.

point will finally begin to fail. Strengthen this one and the next weakest will start to give trouble, and so on during the entire life of the car. Springs varying from 18,000 to 60,000 lbs. capacity have been tried and gave good protection some years ago when cars were of light capacity and handled in short trains, but they do not meet the requirements of today. A large number of railroads, realizing this, have started to replace the spring gear with friction devices that have from three to four times the shock-absorbing capacity that it is practicable to obtain from a spring gear. In a device of this kind there should be no recoil. The force exerted by the recoil of a spring is practically as great as the force to compress it and results in much damage to equipment, especially in long trains.

The following statement gives the actual comparative service performance of these two types of gears, covering a period of twenty-six weeks, and shows very clearly the superiority of the friction gear:

	Number of Broken										
	Couplers.	Knuckles	Knuckle Pins.	Pocket Rivets.	Pockets.	Followers.	Springs.	Draft Spring Castings.	Total Failures.	Number of Cars Equipped.	Per Cent. of Failures.
Various types of spring gears....	1526	710	2421	3143	207	1102	1620	1482	12211	15000	81
Various types of friction gears...	168	93	438	86	12	6	21	4	828	4805	17

The information was compiled from weekly reports submitted by inspectors and shop foremen at every point on the entire system where repairs were made and is impartial and correct. The statement is self-explanatory and needs little comment. The majority of the spring gears were applied to wooden cars, which, to a certain extent, form a cushion themselves and greatly protect the parts susceptible to failures. In order to obtain a correct comparison, only defects that are common to both wooden and steel cars were considered, otherwise the results would have been much more favorable to the friction gear. It is interesting to note that on 4,805 cars equipped with the friction gears there were 828 failures, or 17 per cent. of the total number of cars, while of the 15,000 cars equipped with spring gears 12,211 or 81 per cent. failed, a difference of 64 per cent. in favor of the friction device. A reduction of car failures of this magnitude means a great saving to the railroads in general because of the increased earning power of the cars and the decreased cost of maintenance, lost and damaged lading accounts, delays and interruptions of traffic, transfers of lading and switching through the various terminals. The sum total cannot be estimated, but that it represents an enormous figure I believe we will all agree. It will also be noted that for every coupler broken there were 1.7 knuckle pins which failed, showing that this is the weakest point in the car coupler. We know that the manufacturer as well as the M. C. B. Committee on coupler designs is considering this point and arranging to relieve the knuckle pin of a large part of the work the present design of coupler throws on it.

I fear that some users do not appreciate what a draft gear is called on to do. I am free to confess that up to the time I started to investigate this question some years ago, I did not credit it with being such an important factor in the question of car maintenance, and other expenses incident to car failures. It is the only device that we apply to a car to protect it and its lading from damage. It has no other function to perform. It must destroy shocks from impact, shocks from pulling and shocks due to recoil. I will try and point out a few of the damages occurring to cars because of the draft gear failing to perform the work for which it is intended.

Couplers.—The M. C. B. Association has furnished an elaborate specification, which includes a physical test, to prove the worth of the coupler before it is purchased; yet, after they go into service, they do break in large numbers. If it were possible to put a draft gear between the coupler and the car that would absorb the heaviest shock, we would eliminate broken couplers, and their removal would not be necessary until they are worn out, and I believe the coupler bodies of late design are sufficiently strong to last approximately the life of a car.

Knuckles.—While knuckles wear out in service there are a great many of them that break from shocks, and here again the draft gear that will relieve the coupler from shock also relieves the knuckles. The same conditions hold true of knuckle pins.

Coupler Yokes.—Here again, the failures are due to shocks and I think coupler yokes are being replaced by other forms of attachments, on account of the pocket rivet failures which are due to the rivets being in shear under impact. In several years' investigation of the draft gear question I have satisfied myself that by eliminating this feature, the wrought iron, or forged steel yoke, with 1¼ in. x 5 in. section riveted to the coupler with two 1¼ in. rivets can be operated with very few failures.

Draft Springs.—I think no one will deny that draft springs are destroyed by shock, and with a properly designed friction draft gear I have learned that this failure can be reduced to a very low figure, for the reason that the draft springs are not driven solid even though the gear receives a shock that closes it.

Draft Followers.—Here again we have a very common failure that is due to shock. A large number of modern friction draft gears that I have examined show practically no follower failures. Draft lugs, draft arms, draft sills, dead woods and end sills also fail simply because the draft gear fails to destroy the force of the blow.

Bursted Car Ends.—The end of a car is often burst by the lading it contains or the lading from an adjacent car. In either case it is on account of the lading moving in an effort to perform the work that the draft gear should have done. However, I believe that more attention should be given to re-enforcing this part of the car.

Car Roofs.—Everyone knows of the trouble we are having with car roofs, and I think you will all agree that it would be very little trouble to apply a satisfactory roof, if the car was standing still all of the time, but the roof being located so far above the floor line and the coupler below the floor line, with a more or less weak construction between the roof and the floor, it cannot help but be racked to its final destruction by the shocks delivered to the car through the coupler. It has been stated that a poor roof will last longer on a car equipped with an efficient draft gear than a good roof on a car with a poor draft gear. The writer is not in a position to either contradict or confirm this statement, but I do know that by replacing an inferior gear with an efficient one is equal to strengthening every part of a car that is susceptible to failure from shocks. We can sum the whole situation up and say that anything about the car that is broken by shock or racked by the large number of shocks is chargeable to the failure of the draft gear to perform its work. I am not here to tell you that there is a draft gear on the market that will prevent all of this damage or that the friction device will cure all of the ills to which the freight car has fallen heir, but I do know there is a great difference between the amount of protection offered by the different draft gears, and for this reason I think some standard specification should be adopted for testing draft gears before purchasing in order to know something of their value. I also believe that a great deal can be learned by periodically removing a few of the draft gears for further tests to see the amount of work they will perform. Also check the failures that are occurring in connection with the several types of gears in actual service. It would seem that sufficient data of this character which would permit of a thorough realization of the possible increase of freight car efficiency are not being collected at the present time.

CONCLUSIONS.

In closing, I have to offer as a relief to the present situation:

First—Re-enforcing the older types of cars that will not stand the expense of a steel underframe, with a long metal draft arm that extends through and over the body bolster. This in turn to be re-enforced, with good, heavy compression timbers.

Second—On such cars as will permit of the expenditure, the application of a carefully designed steel underframe.

Third—In all cases apply the draft gear that will destroy the greatest amount of shock with the entire elimination of recoil.

Fourth—The adoption of a standard specification for the testing of draft gear to determine its shock-absorbing capacity, and amount of recoil before purchasing.

Fifth—Substitute for the present wooden roof an all metal one as soon as it has been demonstrated what the proper construction should be.

Frisco Steel Frame Box Cars

The Prevention of Lost and Damaged Freight Claims Given Special Attention in the Design

Within the past two years there has been a rapid awakening to the fact that box cars should not only be designed to properly meet the severe service demands due to the use of larger locomotives, longer trains and the more extensive use of hump yards, but that far more attention should be paid to making the cars proof against damage to and loss of freight. The St. Louis & San Francisco has received an order of 1,000 box cars within the past year, which were designed with the express purpose of providing a weather proof and grain leakage proof structure in connection with the desired strength and durability, as well as providing a smooth style of interior construction, with a view to reducing to a minimum the destruction or injury to package freight in paper bags, boxes, or other insecure packages. These cars are of the outside steel frame or Canadian Pacific construction and have a number of features of unusual interest. They are of 80,000-lb. capacity and have the following general dimensions:

Inside length	40 ft.
Length between end sills	40 ft. 11 in.
Length over running boards	42 ft. 1 in.
Length over striking castings	42 ft. ¾ in.
Center to center of bolsters	31 ft.
Width inside	8 ft. 6 in.
Width over steel side sills	8 ft. 8¼ in.
Height from top of floor to under side of carline	8 ft.
Height from rail to top of floor	4 ft. 1 in.
Height from rail to eaves	12 ft. 5⅝ in.
Width of side door opening in clear	6 ft.
Height of side door opening in clear	7 ft. 7⅜ in.
Truck wheel base	5 ft. 6 in.

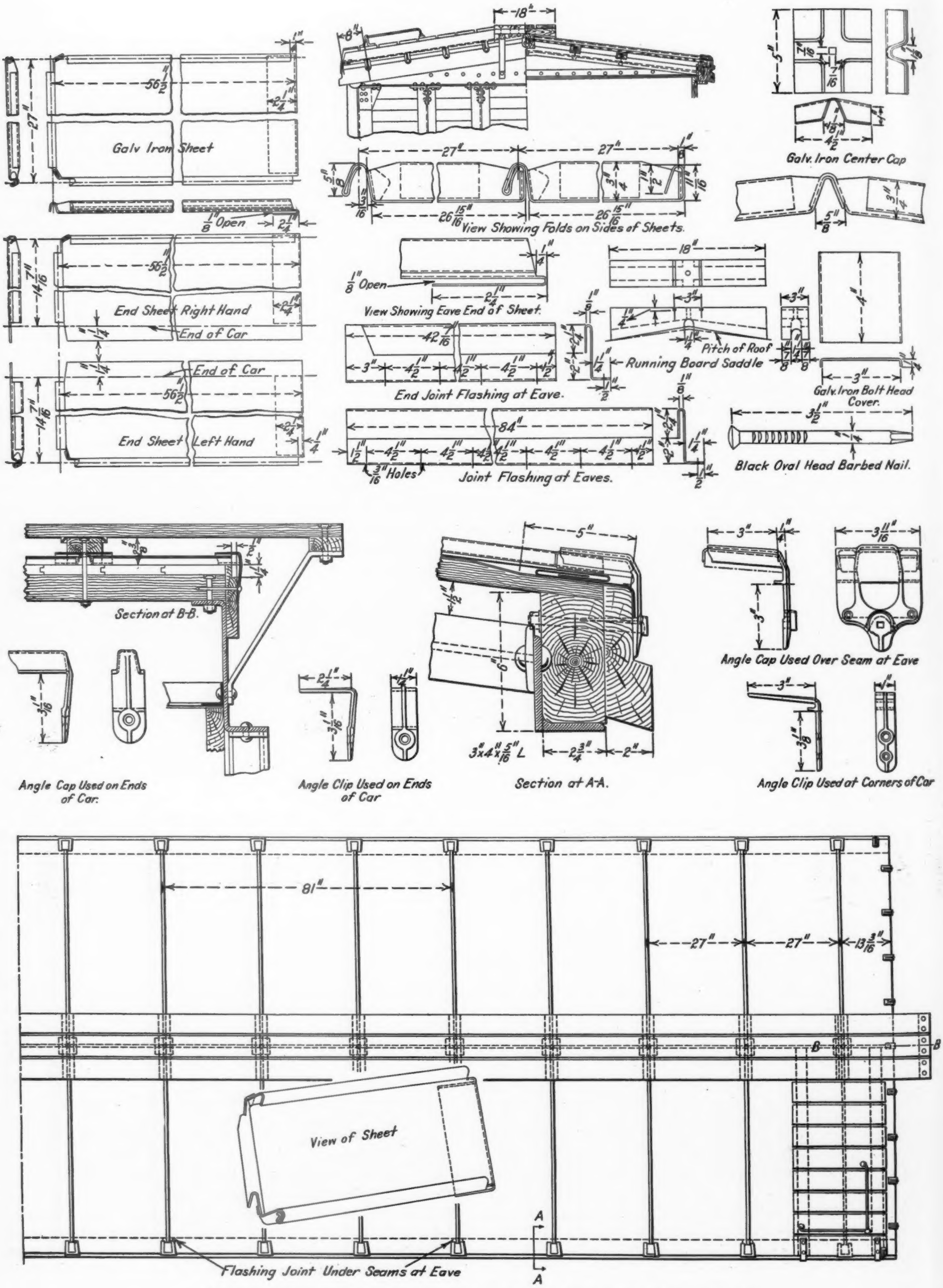
Forty-Ton Outside Steel Frame Box Cars; St. Louis & San Francisco.

The cars are said to be giving splendid satisfaction from the standpoint of being waterproof, burglarproof, and proof against the leakage of grain; and it is expected that they will also give a favorable account of themselves from the standpoint of the cost of maintenance. The steel underframe, together with the steel framing for the superstructure, including the eight Posson I-beam carlines, furnished by the Camel Company, provide a comparatively rigid structure and furnish a much more substantial support for the roof than was usual in the older types of construction. A Murphy outside metal roof, type X L A, is used and as an additional safeguard against leakage, the railroad specified that this was to be placed over a layer of asphaltum coated burlap, which was laid flat on the single course of 13/16 in. yellow pine roofing boards.

The side plates consist of 4 in. x 3 in. x 5/16 in. angles, extending the full length of the car, and with the 4 in. flanges vertical. The side posts are 3 in., 6.7 lb. steel Z-bars, which extend from the underside of the side plate angle to the bottom of the bolsters and cross-bearers, to which they are riveted. The center side braces are also 3 in., 6.7 lb. Z-bars, while the intermediate side braces are 3 1/16 in., 8.4 lb. Z-bars. The door posts are 4 in., 8.2 lb. Z-bars, as are also the end posts at the center. The intermediate end posts are 3 in., 6.7 lb. Z-bars. The corner posts are 5 in. x 4 in. x ⅜ in. angles, which extend from the underside of the side and end plates to the underside of the end and side sills. Angles of ⅛ in. pressed steel at each corner of the car perform the function of rain caps, closing the joint between the side and end plates and protecting the top of the corner posts.

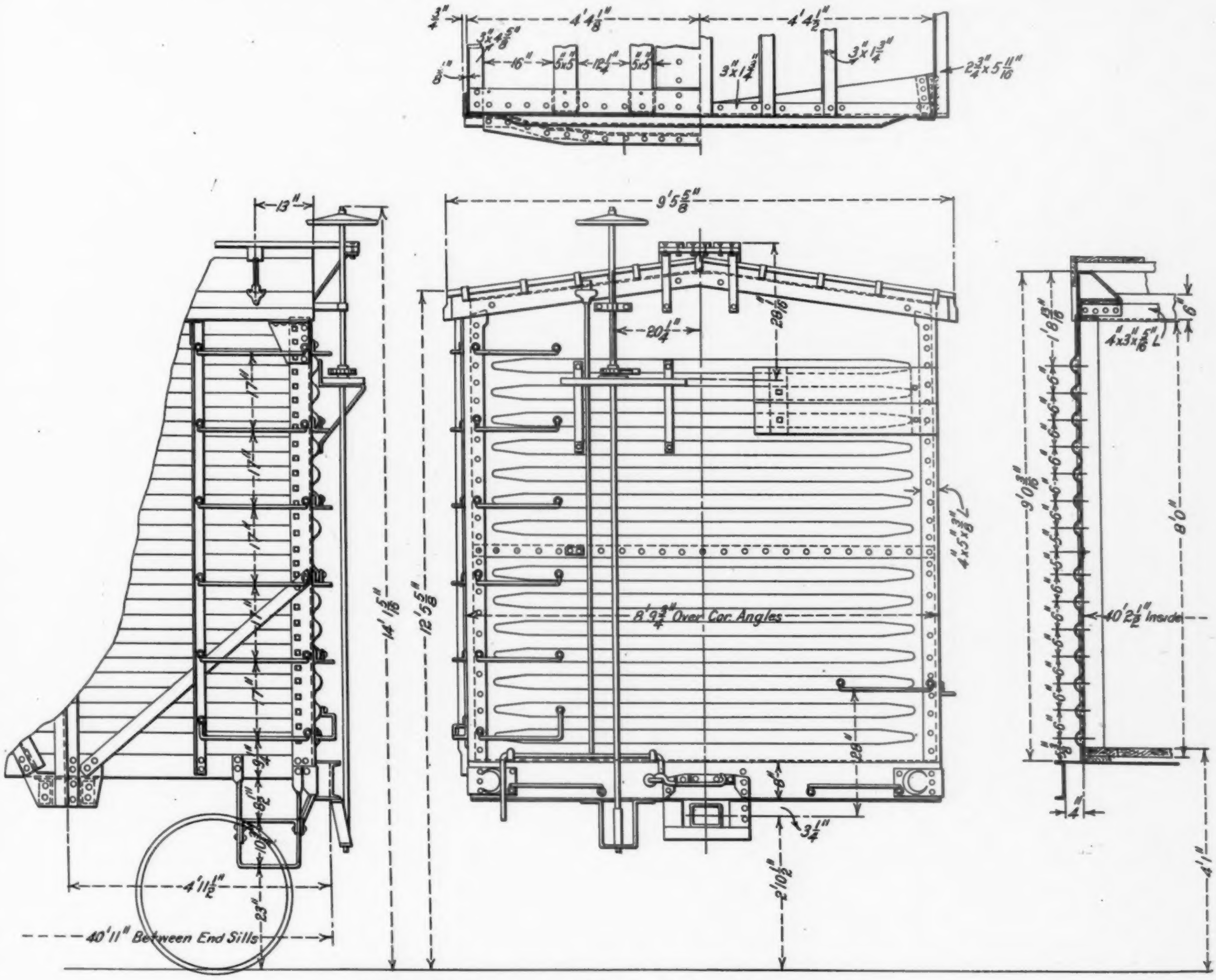
The end plates are of 3/16 in. material flanged to a Z shape, 10 15/16 in. deep at the center and tapering to the side plates with the ends flanged around and riveted to the side plates. The end plate has a 3⅛ in. flange at the top, which turns in and provides a bearing for the ridge pole and purlines. At the bottom it has a 4 in. flange turned outwardly to form a bearing for the end and corner posts. The ridge pole is of yellow pine, 2 3/16 in. x 5 in., and the purlines are 1¾ in. x 3 in. The side fascia is of yellow pine, 2 in. x 6¼ in., and the end fascias are 1 in. x 6¼ in.

The frame work, being on the outside, makes it necessary to provide an inside lining only as shown on the drawing, and the sheathing is in narrower widths than usual with a view to reducing the shrinkage of the side planks. Ordinarily in this type of car the material is used in 5¼ in. widths, while on the Frisco cars it is only 3¼ in. wide. The lining, which is 1½ in. thick, is connected to the members of the metal frame work by ⅜ in. carriage bolts. The lower side board is cut in ½ in. at the floor level to allow the floor planks to pass under the edge. At the ends of the car the floor board is gained ½ in. to allow the lower end lining board to fit below the floor level,

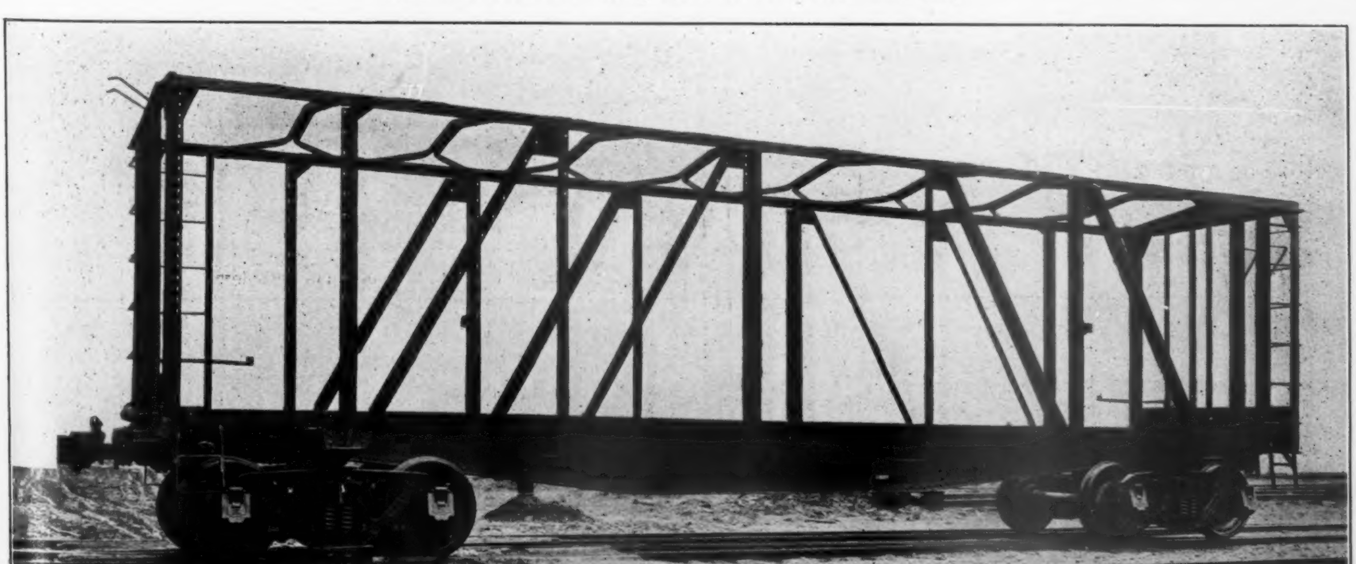


Construction and Details of Murphy X L A Roof as Used on the Frisco Box Cars.

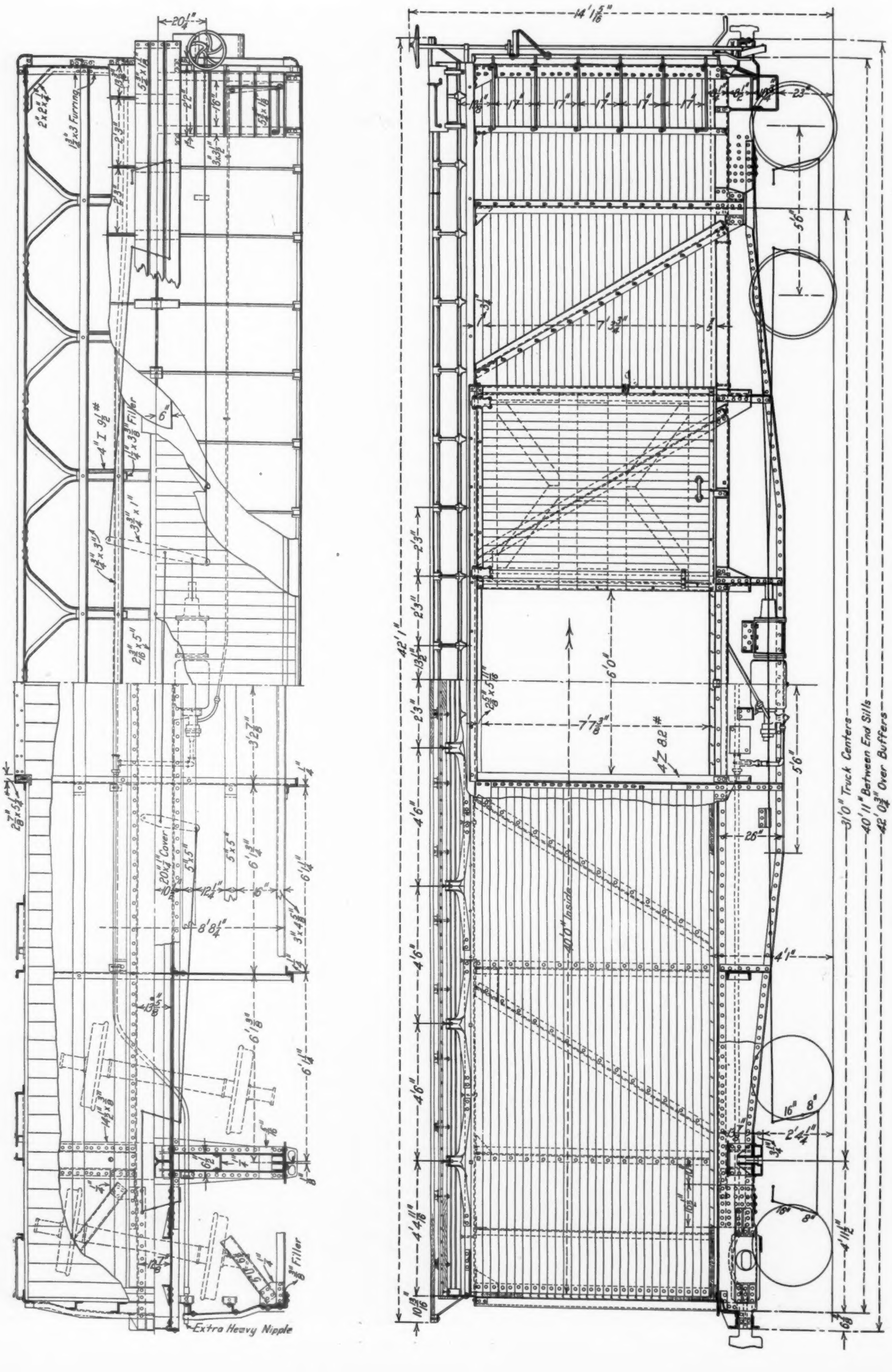
thus insuring a tight fit. The end is also reinforced at the bottom of the lining for the full width of the car by placing a ¼ in. steel plate on the outside of the lining, extending about 9 in. above the floor and riveted to the end and corner posts. The lower edge of this plate is flanged at the bottom and is riveted to the end sill cover plate. This not only stiffens the ends but is an additional precaution against the leakage of grain at that point. The flooring is of yellow pine, 1¾ in. in thickness, and is nailed to side nailing stringers of yellow pine, 3 in. x 4⅝ in., and two center and two intermediate stringers,



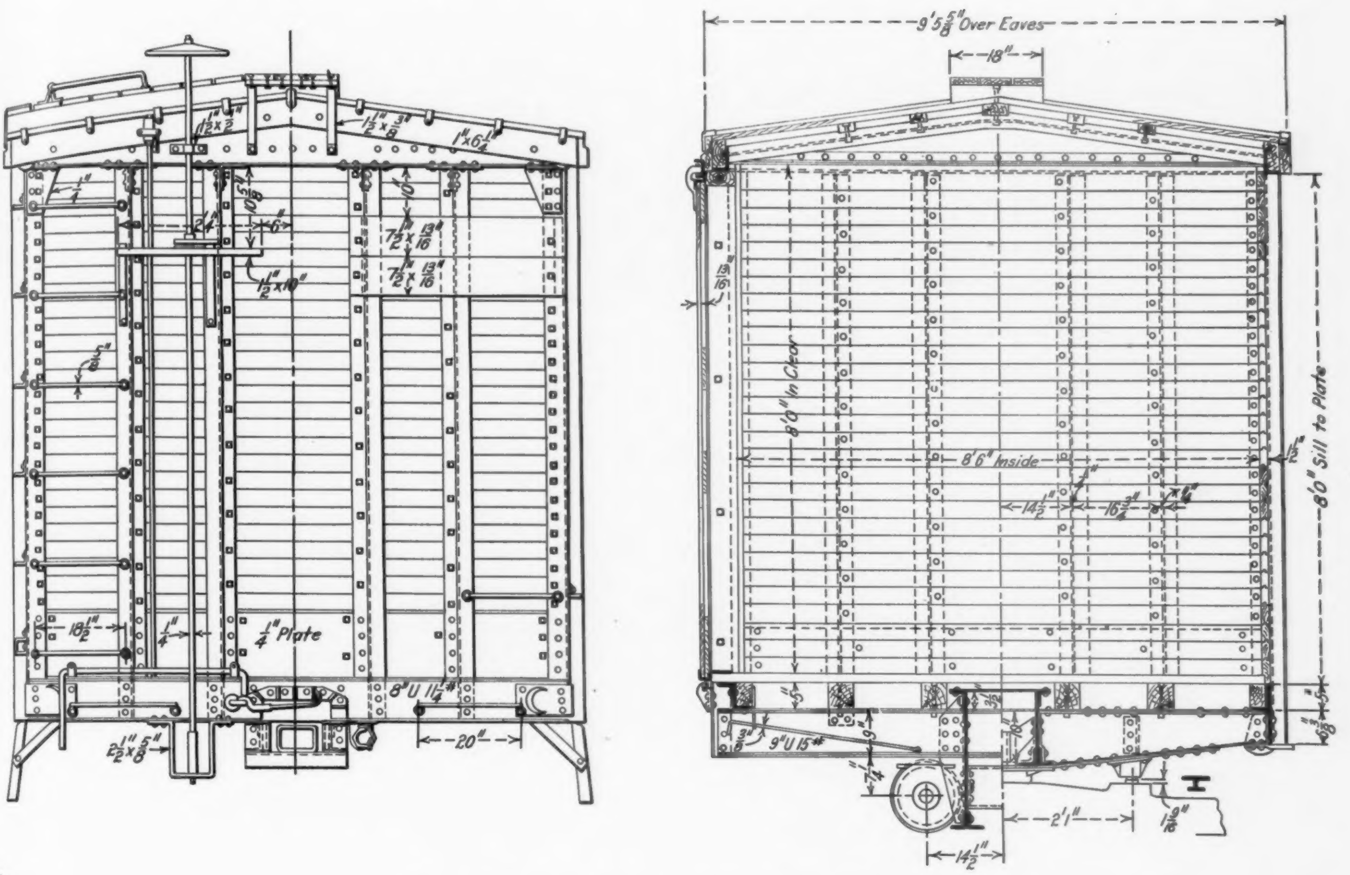
Steel End Used on Twenty-seven 40-Ton Frisco Box Cars.



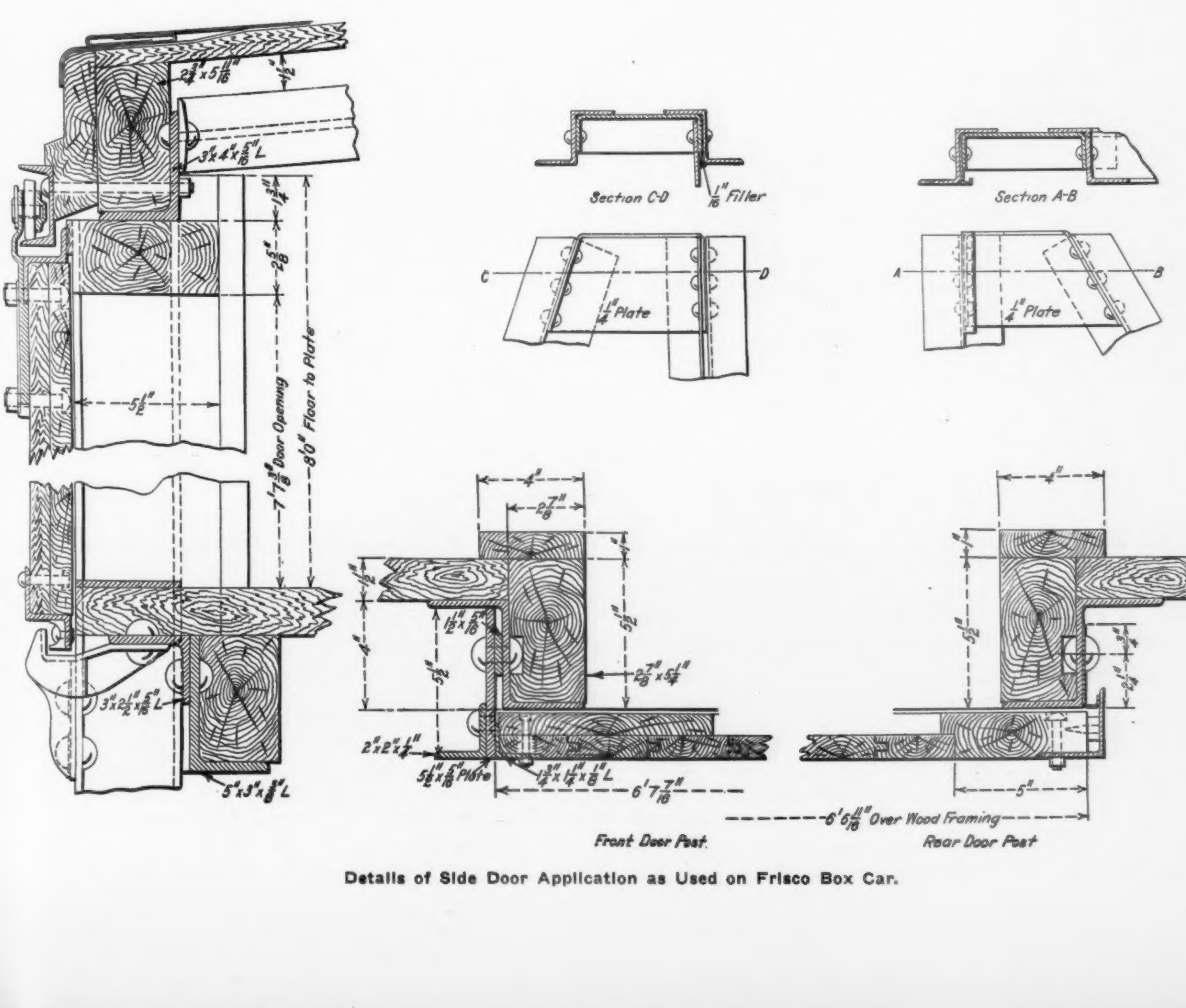
Steel Frame for Frisco 40-Ton Box Cars.



General Arrangement of Outside Steel Frame 40-Ton Frisco Box Car.



End and Sectional Views of 40-Ton Frisco Box Cars.



Details of Side Door Application as Used on Frisco Box Car.

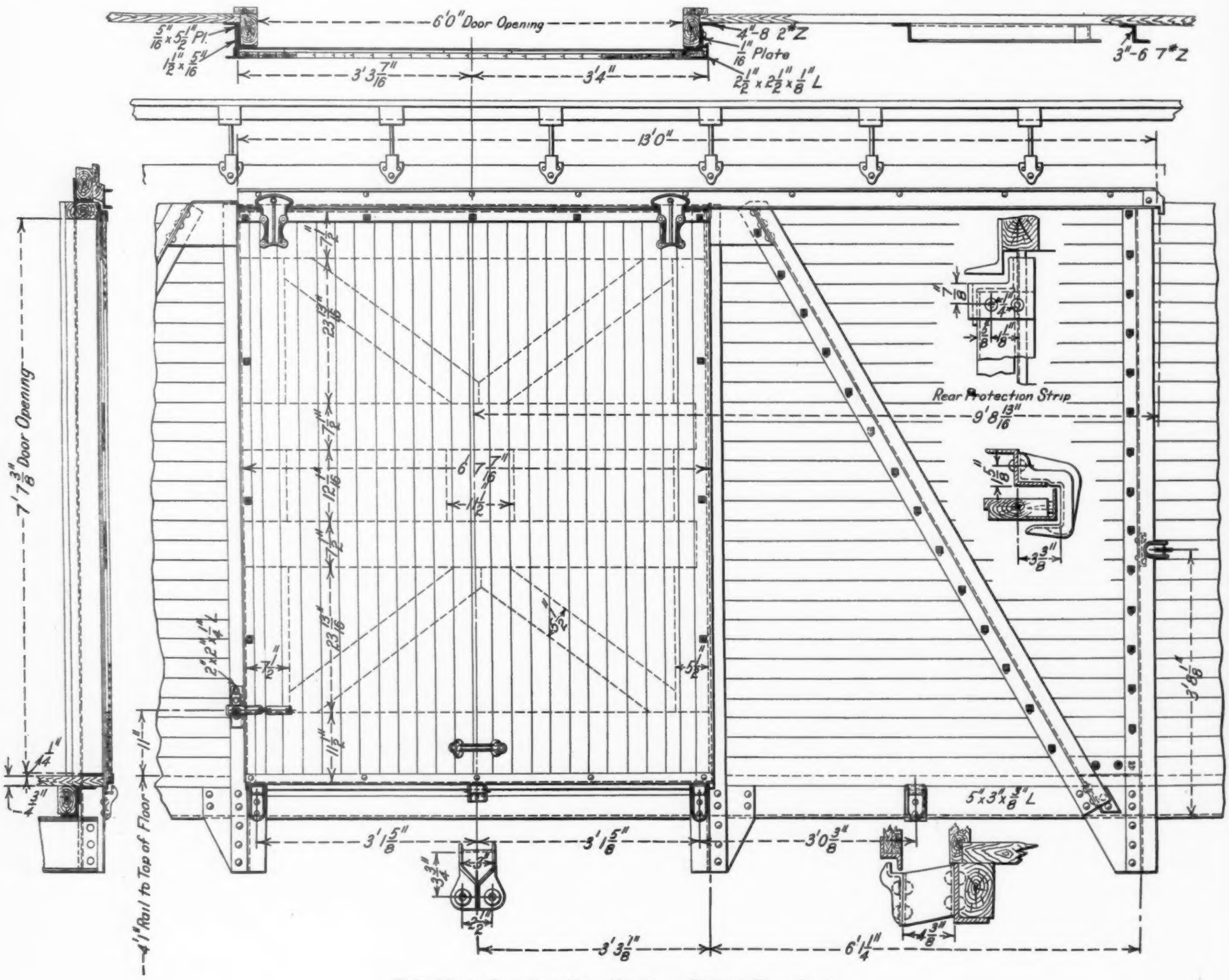
5 in. x 5 in. The flooring at the door openings is supported by 3 in. x 2½ in. x 5/16 in. angles, riveted to the side sill angle.

Wooden ends were used on 973 of the cars and corrugated metal ends furnished by the Standard Railway Equipment Company were placed on 27 of the cars for test purposes. Details of both of these ends are shown in the drawings.

The side doors are equipped with Jones Peerless fixtures and Positive malleable iron door fastenings. The bottom guides are riveted to the door post, floor support angle and the ¼ in. bracket. The door is stiffened horizontally at the top and the bottom by 1¾ in. x 1¾ in. x 1¼ in. x 3/16 in. Z-bars; it is stiffened vertically at the front edge by a 1¾ in. x 1¼ in. x ⅛ in. angle, and at the rear edge by a 2½ in. x 2½ in. x ⅛ in. angle. The front edge of the door is protected against weather, cinders,

10 in. back of the center line of the bolster. A 20 in. x ¼ in. center sill cover plate extends for the full length of the car. The draft sills are of ⅜ in. pressed steel plates flanged to Z shape, and are connected to the striking castings at the front by 3 in. x 3 in. x 5/16 in. angles. Cardwell type G-11 draft gear is used with Latrobe 5 in. x 7 in. shank steel couplers. The couplers are controlled by the Imperial Appliance Company's uncoupling device.

The side sills are 5 in. x 3 in. x ⅜ in. angles extending the full length of the car and are secured to the end sills by ¼ in. pressed steel combined corner bands and push pole pockets. These sills rest directly on top of the bolsters and cross-bearers with the 5 in. leg vertical. The end sills are 8 in. channels weighing 11.25 lbs. per ft. The end sill top cover



Side Door Construction Used on Frisco Box Cars.

etc., by a 5/16 in. vertical bar which is riveted to the door post and spaced 5/16 in. from it by a filler, the bar abutting the front edge of the door when the door is in a closed position. The rear edge of the door is protected by a 1/16 in. steel bar which is riveted to the door post and is bent in a U shape to form a contact with the vertical rear door edge stiffener angle.

The center sills consist of ¼ in. web plates with 3 in. x 3 in. x ¼ in. top angles and 3 in. x 3 in. x ⅜ in. angles on the outside at the bottom and 3 in. x 3 in. x 5/16 in. angles on the inside. The web plates are continuous between the bolsters and extend 2 ft. 2½ in. beyond them in order to provide for the splicing of the draft sills. The center sills are 26 in. deep at the center for a distance of 11 ft. and taper to 13⅞ in. in depth,

plate is 12 in. x ¼ in., shaped to conform to the contour of the end sills.

The body bolsters consist of 5/16 in. pressed steel channel plates placed 6½ in. apart back to back. The top cover plate is 14½ in. x ⅜ in. and passes through slots cut in the center sill webs. The bottom cover plate is 18 in. x ⅜ in. The center filler is of malleable iron; a steel casting forming a combined roping and jacking casting is applied at the ends of the bolster. The diagonal braces in the underframe extend from the juncture of the side and end sills to the juncture of bolster and draft sill and consist of 5 in. 6.5 lb. channels placed with the flanges down. There are four 9 in. channel floor beams, weighing 15 lbs. per foot, which extend the full width of the car and pass through slots which are cut in the center sill web. They pass under the side sill and form a direct connection with the Z-bar side posts.

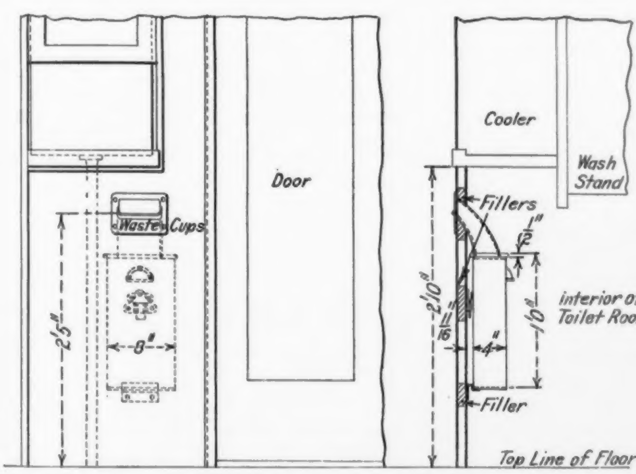
The trucks have cast steel frames furnished by Scullin-Gallagher Iron & Steel Company, and the cast steel truck bolsters were made by the same company. These cars were built by the American Car & Foundry Company.

RECEPTACLE FOR WASTE DRINKING CUPS

BY JOHN H. NAGLE,
Chief Draftsman, Buffalo, Rochester & Pittsburgh, DuBois, Pa.

A very neat and satisfactory arrangement for the disposal of waste drinking cups in passenger cars, has been designed for use on the Buffalo, Rochester & Pittsburgh. Since the railroads have been using sanitary drinking cups it has been found necessary to provide some means of collecting the used cups, as they were thrown on the floor, the result being that the floor around the cooler was always wet and presented an unsanitary appearance.

As shown in the illustration, a small cast iron chute is placed



Chute and Receptacle for Waste Drinking Cups.

through the wall of the toilet room, directly under the water cooler. On the wall inside directly under the chute is a galvanized iron can of suitable size, supported on the wall by a male and female bracket, which allows the can to be removed for cleaning. In this way all the used cups are collected, as well as any water which remains in them. This arrangement is hidden from view from the outside, with the exception of the front of the chute, on which is cast in raised letters the words "Waste Cups."

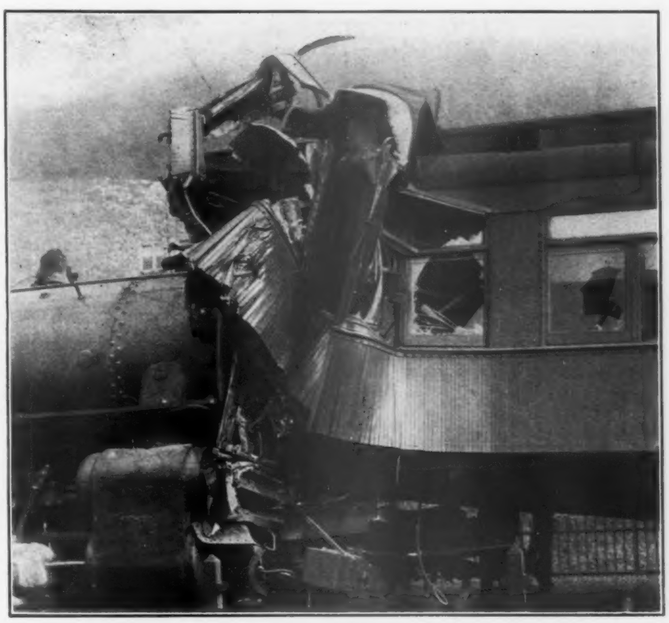
Steel Cars in the Tropics.—It has, hitherto, been considered inadvisable to operate steel passenger cars in tropical countries, because of the climatic conditions which prevail there, and in adopting a new type of all steel cars for passenger service the South Indian Railway would seem to be embarking upon a policy which has, up to the present, remained untried. Although the cars are of steel construction, every precaution has been taken in designing them to avoid the risks and inconveniences which otherwise would have been experienced. The tests made with the cars have shown remarkably good results. In the matter of internal temperature some very satisfactory results have been reached, a saving in weight, as compared with the latest wooden cars of the same dimensions, has also been effected. This saving would undoubtedly have been exceeded had the designers preferred not to make too sudden a departure from existing standards. It is interesting to note that several other railways in India and Egypt have placed orders with the manufacturers of these South Indian Railway cars for steel coaches.

STEEL PASSENGER CARS IN A WRECK

A recent rear-end collision between two passenger trains of about equal weight, and each composed of all-steel equipment, illustrates what can be expected of the all-steel passenger car when subjected to the severe punishment of a collision.

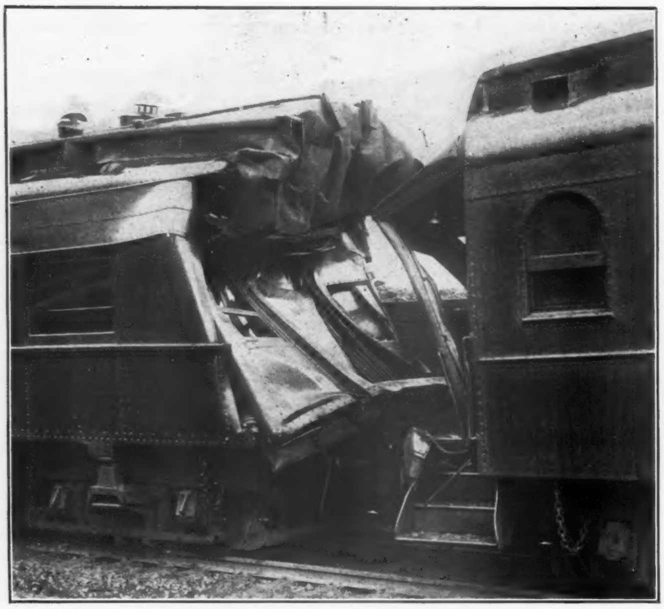
In this case a train consisting of a Pacific type locomotive, a steel postal car, two steel postal storage cars, two 70-ft. all-steel coaches, a steel parlor car, steel dining car and a wooden private car, when running at a speed estimated at between 30 and 35 miles an hour ran into the rear end of a train drawn by a similar type locomotive and having eight all-steel cars as follows: one postal car, one baggage car, four coaches, one dining car and one Pullman parlor car. The latter train was just moving from the station and at the time of the collision had proceeded about one car length. The colliding train had a weight of approximately 730 tons, including the weight of the locomotive, while that which was just leaving the station had a weight of somewhat over 700 tons, also including the weight of the locomotive and tender.

The rear car of the forward train was the Pullman parlor car, and this received the greatest amount of damage. The report of the Interstate Commerce Commission states that the locomotive crushed the rear end of this car for a distance of 10 or 12 ft. The distance from the buffer to the center plate of these cars is 11 ft. 10¾ in., which would indicate that the locomotive did


Rear End of the Parlor Car; the Point of Collision.

not pass entirely through the combination steel body bolster and end casting. This would mean a penetration inside the end of the car of about 8 ft. That the destruction up to this point was complete is well shown in the photograph, and it will be noticed that, with the exception of broken window lights, the structure of the car is practically intact beyond the point of actual penetration.

The next car ahead of this was an all-steel dining car, and the vestibules of both of these cars were badly crushed. As will be seen in the illustration, the platform of the dining car passed over that of the parlor car, shearing the vestibule diaphragm and corner posts from the underframe. This action was probably caused by the lifting effect of the locomotive on the opposite end of the car, which would tend to throw the platform at this end under that of the dining car. The shearing of the posts and other parts of the vestibule drew down the hood, and this in turn crushed down on the top of the vestibule of the dining car, forcing it through the end framing slightly. It will be noted, however, that all the members of the dining car structure held together, and the action throughout is a crushing effect of bending the sheets, but apparently not rupturing any of the main parts of the structure. This indicates that if the shock had been greater,



Another View of the Rear End of the Dining Car.

and more of it had been absorbed at this point, the crushing would have continued in this crumpling effect. It should be noted, however, that in spite of the fact that the platform of the dining car lifted over the underframe of the parlor car, there was no penetration of the end framing of the latter at this end.

No other cars of this train were materially damaged, with the

Rear of the Dining Car and the Front End of the Parlor Car.

exception of the pulling out of a coupler on the front car, which was probably the result of the reaction of the heavy locomotive at the head end, which was already in motion.

The action of the cars in the colliding train, however, should be considered, for it will be seen that a considerable proportion of the shock was absorbed by their action, and apparently the damage done to the forward train was caused by absorbing the blow from but little more than the locomotive alone. The tender of the colliding locomotive was thrown from its frame and came to rest on an adjoining track, and at right angles to it. The postal car, directly behind this, was thrown from the rails and diagonally across the next track, coming to rest with its forward end on the adjoining station platform. One end of this car was crushed in for some distance, and the roof over half of the car was out of alignment. The crushing of this car, however, is very similar to that which took place on the dining car, and consists simply of the distortion and crumpling of the sheets and members in the upper part of the framing without any appreciable tearing or separation of the various parts. The underframe is distorted and twisted as far as the bolster, but the connections between the members are nearly all intact. The opposite end of the postal car and adjoining baggage car were slightly crushed and the remaining cars in the train suffered slight damage, consisting principally of broken windows and fixtures.

The indications from this collision are, that with cars of all-steel type the effect of the blow and momentum of the train will be absorbed first by the dislodging of a car from its position if possible and throwing it across the adjoining track, and secondly, by the crushing of the vestibules and platforms of the cars immediately adjoining the point of collision. If the various members at the end of the cars are securely fastened there will probably be no considerable penetration of the car bodies except at the point where the locomotive itself strikes, and that even here the penetration will not usually extend much beyond the center plate.

GASOLENE SPEEDERS IN FIRE PREVENTION.—The Department of Agriculture says that the government's forest rangers are using gasolene railway speeders for fire protection purposes. They follow up trains on steep grades where sparks thrown out by the locomotives are likely to start fires along the right of way.

THE SECOND SIMPLON TUNNEL.—A correspondent writes: The boring of the second gallery of the Simplon tunnel is advancing steadily, 1,367 workmen being employed in the tunnel itself, and 816 outside it—in all on an average 2,183 per day. The work is in the hands of the Swiss Federal Railways, and is being supervised by Chief Engineer Rothpletz, who was also the chief engineer of the Loetschberg tunnel. Originally there was talk of handing over the contract for the work to a German firm, whose tender was lower than that of any Swiss firm, but owing to the outcry raised by the Swiss engineers, and more or less by the Swiss in general, the Federal railways decided to be their own contractors.

BURMA RAILWAYS.—The Burma Railways Company, Ltd., is hampered by the action of the railroad board, which reflects the attitude of the government of India. The railway board is alternately accused of extravagance and of parsimonious neglect, but the former is neither required nor desired in the case of Burma. The traffic returns of the Burma Railways last year bear eloquent and conclusive testimony to the advantages of a forward policy of railroad building. The number of passengers carried on the main line and the Pegu-Moulmein and Henzada-Kyaungin extensions was 23,966,266, an increase of over 2,000,000 as compared with the previous year. Both on the main line and on the extensions the percentage of expenses to earnings fell, and the percentage of earnings to capital outlay everywhere increased. Figures like these are very satisfactory in themselves and amply warrant the belief that if further extensions were undertaken—and especially if the construction of the through connection to China were placed in the hands of the Burma Railways Company—the financial and commercial benefit to Burma would be large.

New Devices

FOSDICK HORIZONTAL BORING, DRILLING AND MILLING MACHINE

A number of important improvements have been made in the new design of horizontal boring, drilling and milling machine of the Fosdick Machine Tool Company, Cincinnati, Ohio. Among them are: A better centralization of the controls, narrow gibbing surfaces, steel gearing cut with special cutters, self oiling bearings, phosphor bronze bushings, positive, hardened clutches, precision micrometer dials that can be set to zero at any position and the thorough incasing of the moving parts.

The general appearance and the arrangement of the various parts are well shown in the illustration and reference needs to be made to only a few of the more important features that are not clearly visible.

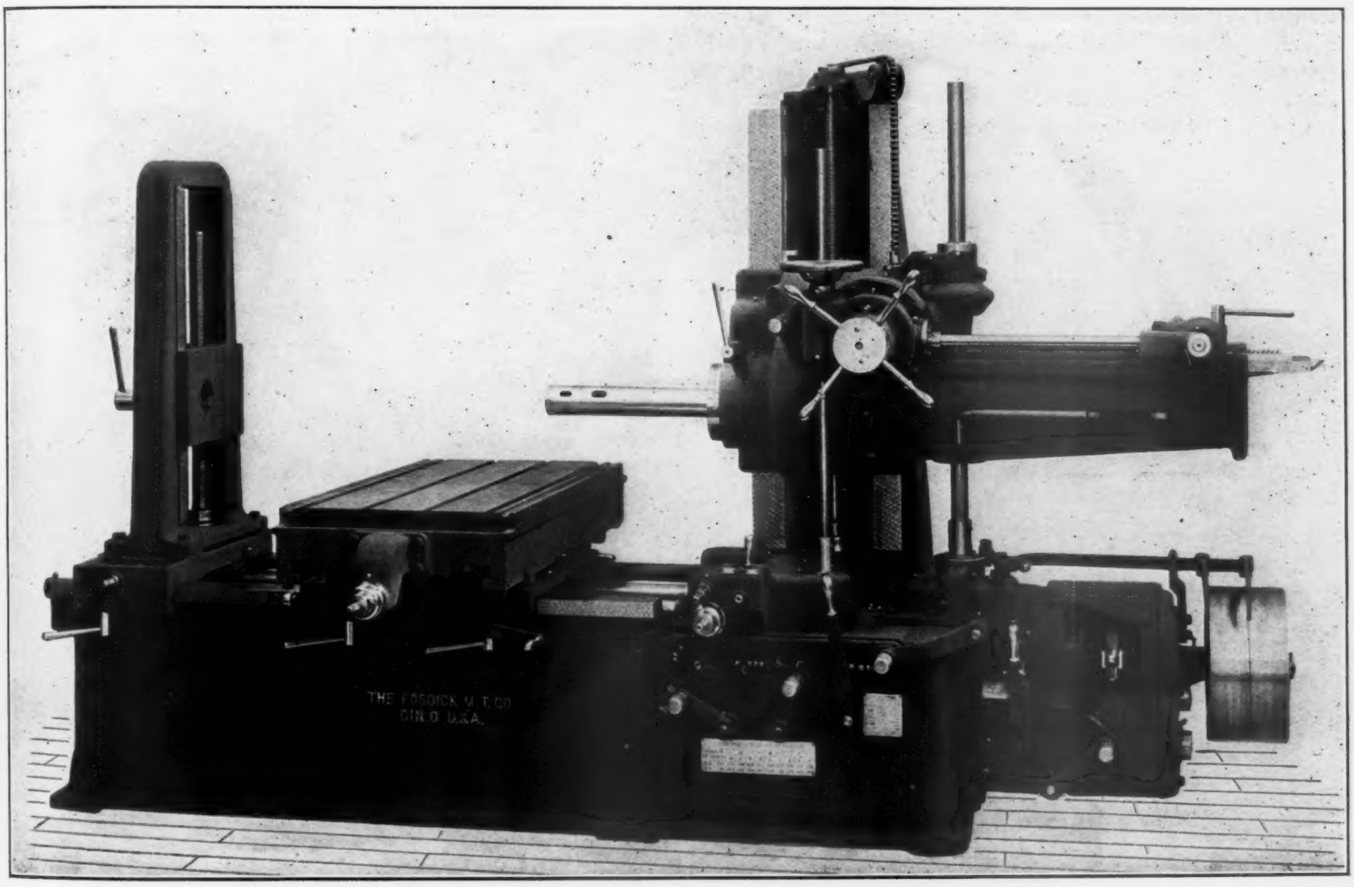
The bed is extra deep and is very well ribbed, giving it a rigidity which makes the machine self-contained and a foundation unnecessary. There are chip chutes arranged to carry the chips and dirt to the rear of the bed. An extra wide space is arranged for the seating of the heavy box column which positively insures its alinement.

The head and the outer support are raised and lowered simultaneously by a rapid power traverse by hand or by the feeds. The elevating screw is suspended from a ball bearing at the top to avoid buckling. This screw has been given special attention to insure the accuracy of the thread and the positiveness of its work. Automatic safety trips are provided for both extremes of the movement of the head.

The spindle is of high carbon crucible steel accurately ground and is fitted with Morse taper and cotter keyway. It is driven by two long driving keys and slides in a sleeve with phosphor bronze bushings tapered to take up the wear. The thrust is taken on a ball bearing. The quick advance and return turnstile is conveniently placed at the front of the head. A special device is provided in the sleeve by means of which the spindle can be held in perfect alinement after any amount of wear.

The feed is composed of all steel slip gears and is entirely enclosed. The changes are made by two handles in front of the casing without stopping the machine and a safety friction device, adjustable from the outside, prevents accidents. The rates of feeds are given on a metal feed plate and are the same for the spindle, saddle or head in any direction, and the selection is made by one handle. This makes it impossible to get any but the required movement of any of these parts. The direction of feed reverses with reversing the spindle and stops with the stopping of the spindle. An independent feed reverse gear is provided. Power rapid traverse to all parts is always in the direction opposite to the feed.

A direct reading index over the speed changing handle gives the number of revolutions per minute of the spindle. The drive is direct and requires no countershaft. A novel overtake clutch keeps the machine running at reduced speed when making changes. This practically eliminates the shock. The reverse



Centralized Control Has Been Made a Special Feature of this Horizontal Boring Machine.

mechanism is embodied in the construction, and it is operated by a lever on the front of the machine. All levers are secured with latches to prevent chattering on heavy work.

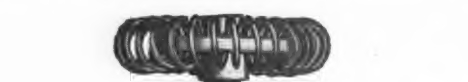
When used as a motor driven machine a five horse power constant speed motor of any speed may be employed.

Some of the more important dimensions are given in the following table:

Diameter of the spindle bar	3⅛ in.
Traverse of the spindle	26 in.
Vertical adjustment of the head on the column	25½ in.
Maximum distance of table to the center of spindle	26 in.
Distance from the face of the spindle to the boring bar support	5 ft.
Size of table	24 in. x 50 in.
Cross travel of the table	30 in.
Longitudinal traverse of the table	32 in.
Number of spindle speeds	16
Range of spindle speeds	12 r. p. m.—225 r. p. m.
Number of feeds in all directions	18
Range of feeds	.004 in.—.396 in.
Speed of the driving pulley	300
Approximate net weight	8,500 lbs.

SAFETY SQUIRT FOR SPRINKLING COAL

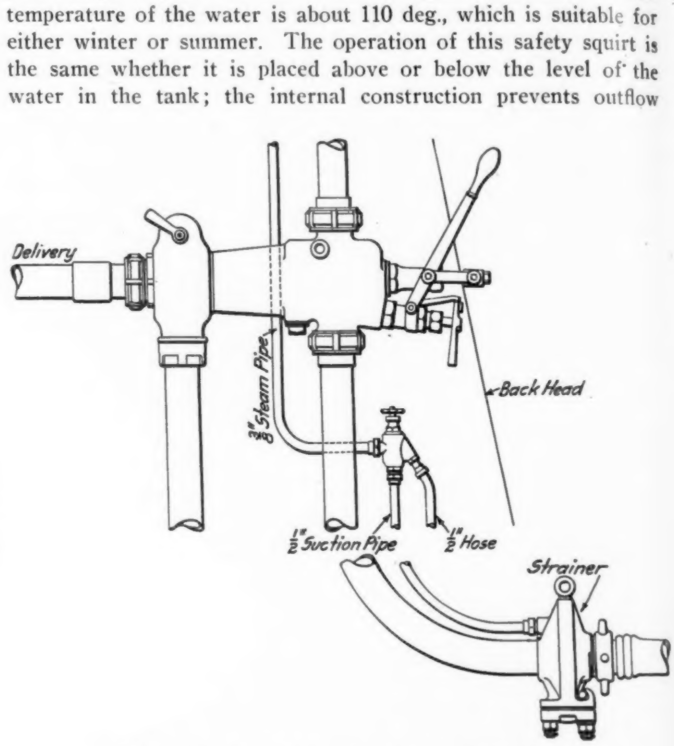
The long established and simple method of wetting the coal in the tender by means of a squirt hose is one of the most recent locomotive attachments to receive radical improvement. The last annual report of the chief inspector of locomotive boilers of the Interstate Commerce Commission records 243 accidents due to the failure of such apparatus, of which a large proportion might have been avoided by the introduction of a safety device. These accidents were due to the bursting of the hose and the scalding of the enginemen and to the slipping of the hose from its union, etc.



Safety Device for Wetting Locomotive Coal in the Tender.

The old arrangement has, however, the advantage of simplicity and ease of operation. It requires little trouble to open the valve from the injector delivery or from the boiler, and were it not for the excessive temperature of the water used and the high pressure in the hose, there would be little danger of accident. A superseding device therefore must be convenient and simple to operate, and deliver a low pressure jet of cool water.

The accompanying illustrations show a safety squirt, which has been produced by William Sellers & Company, Incorporated, Philadelphia, Pa., It is operated by steam from the boiler and is connected by a ½-in. pipe to the strainer on the left hand injector for its water supply. Opening the valve at the top produces a strong suction which lifts the water supply, discharging a low pressure jet through a 5/16-in. nozzle the full length of the tender. The temperature of the water is about 110 deg., which is suitable for either winter or summer. The operation of this safety squirt is the same whether it is placed above or below the level of the water in the tank; the internal construction prevents outflow through the hose when it is placed under a head of water, or if the injector is used as a heater. The suction branch contains a water check valve which is normally closed, but opens automatically when steam is admitted by the valve at the top. This device is now in quite extensive use and is giving good service.

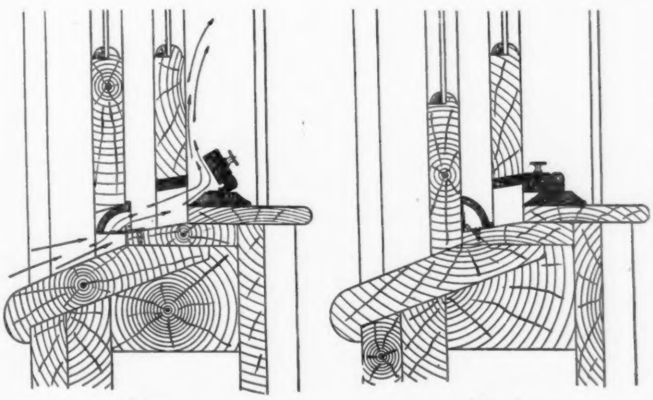


Sellers Safety Squirt Applied to a Locomotive.

CAR WINDOW AIR INTAKE

Up to within a few years, about the only means of ventilating a car was by opening the deck sash or the side windows. There are now in use, however, several types of exhaust ventilators usually placed at the deck sash openings, which materially aid in producing a circulation of air through the car. Since the steel car is now rapidly superseding the wooden car, the amount of air leakage around windows and doors is much less than it has been with the wooden car, due to the improved fittings around the windows and doors, and providing for the admission of the proper amount of fresh air into a steel coach, and particularly into the lower berth of a sleeping car, without discomfort to the passengers, has been something of a difficult problem in car ventilation. It is very objectionable to have currents of cold air blow down on the passengers from deck sash openings, and it is likewise disagreeable to have cold air blow into a window or lower berth direct from the outside.

Fresh air should not be allowed to enter a car in large quantities at one or only a few points, but should be admitted through a large number of small openings. With this arrangement there will be no discomfort to the passengers and at the same time there will be a sufficient amount of air enter the car to cause a steady flow of the air exhaled by the passengers out through the exhaust ventilators. A plan for obtaining "free leakage" of air through the car windows without raising the windows has recently been devised. The device is so constructed that the outside air can be admitted at any window without opening the window and is regulated by the occupant of the seat or berth. Hinged to the sill between the outer and inner windows is a quarter round strip hollowed out, except at reinforcing sections and extends the entire width of the window. A perforated metal screen is placed over the outer flat side to keep out cinders. When the intake is not to be used the quarter-round strip is turned over to lie on the sill between the two windows and the outer window rests on the sill in its normal closed position, as is shown in the illustration. When it is desired to use the intake, the outer window is raised 1 in., the quarter-round strip turned outward and the window allowed to rest on the strip as shown. A stop is attached to each end of the strip so that it will always be in proper position for the window to rest on it. Attached to the bottom of the inner sash is a strip of wood with notches or openings through which the air can pass. This strip also extends the full width of the window and is screwed permanently to the bottom sash rail. These air passages are opened or closed by another strip of wood which



Open. Closed.

Garland Air Intake for Coaches or Sleeping Cars.

extends the width of the window and is hinged to the sill. The edge of this strip closes down against the face of the inner bottom sash rail and completely seals the openings. To prevent air from passing into the car under the strip when it is closed, a tongue and groove is placed at the hinge line. For application to cars now in service, this inner regulating strip is hinged to another strip which is fastened on the present window sill as shown. The edge of the bottom strip next to the window is beveled to increase the open area.

A spring pin is placed in each end of the regulating strip which rubs against the window frame and holds the strip in whatever position it is placed. The passenger can, therefore, admit a small or larger amount of air through the intake as may be desired. The air is deflected upward against the window and does not strike the occupant of the seat or berth.

The device can be applied to cars now in service without cutting any part of the window framework, the strips being attached with a few screws and will not in any manner interfere with the operation of the window.

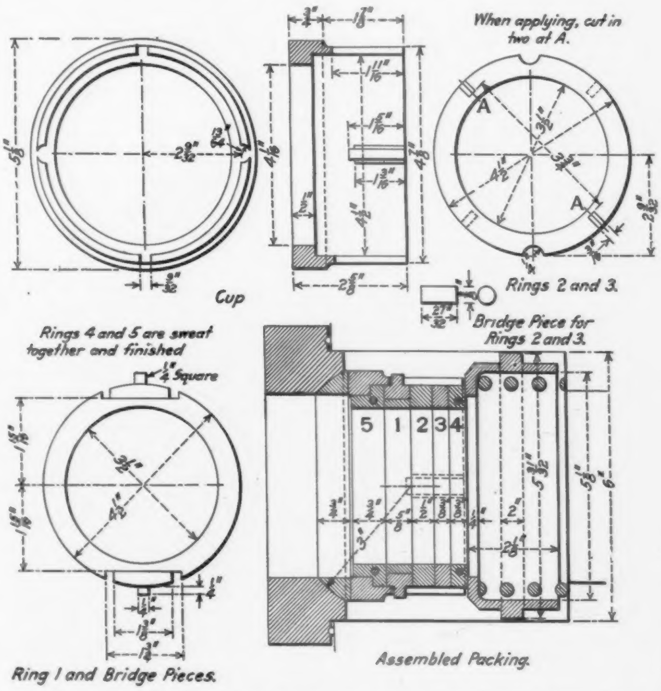
The device is the invention of Thomas H. Garland, and is being handled by Mudge & Company, Railway Exchange, Chicago.

Light Railways in Japan.—The British vice-consul at Yokohama reports that numerous light railways have been constructed during the last few years, and there are now within the consular district of Yokohama no less than 271 miles of light railways, while another 238 miles are either under construction or consideration. So far, he adds, nothing further has been heard regarding the scheme for converting the Tokaido railway track into a standard gage system, which was first mooted several years ago, but subsequently abandoned owing to the enormous outlay it would involve.

METALLIC PACKING

The metallic packing shown in the illustration consists of a cup containing three packing rings and two carrying rings. The cup has four slots, set 90 deg. apart, through which steam reaches the outside surface of the packing rings. The slots also serve to engage lugs and bridges to prevent the rings turning inside the cup, while the cup and rings as a whole are free to revolve about the rod.

The smallest bore of the cup is large enough to go over the enlarged end of the piston rod. The carrying rings are made in halves when the piston rod has an enlarged crosshead fit, but in other cases they are in one piece. Of the three packing rings, two are alike, but may be of different thickness to facilitate assembling. Packing ring *1* consists of two symmetrical pieces with a flattened portion as shown, the flat part covering the joint or opening. These flat parts form the two bridge seats; besides being flattened on the outside the halves are cut out 1/4 in. to allow an opening and closing movement. On the two bridge seats are placed bridges of exactly the same width as the ring, and having an outside radius corresponding to the ring itself. Each bridge has a lug to engage in the slot in the cup and prevent the ring from turning. The bridge extends almost across the flattened seat when the ring is closed, but each half ring can slide under the seat to the small extent allowed by the



Smith Metallic Packing as Applied to a Wabash Locomotive.

cup. When steam is admitted through the slots in the cup against this ring, it will close around the piston, the ends of the two halves approaching each other. Rings *2* and *3* are also made in halves, with 3/16 in. cut out to allow for opening and closing. Each of these halves has a half round cut in its outside circumference to correspond with two of the slots in the cup, so that a simple round bridge piece engaging the slots in the cup and these half rings holds them from turning in the cup. These two round bridges fit loosely and should be slightly shorter than the combined width of the two rings, so as not to hold the rings apart. Rings *2* and *3* are placed in the cup so as to break joints with each other, and also with ring *1*. There is no pressure on the rings when steam is shut off and the cup and rings as a whole float about the rod, the carrying rings supporting the cup when steam pressure is not present.

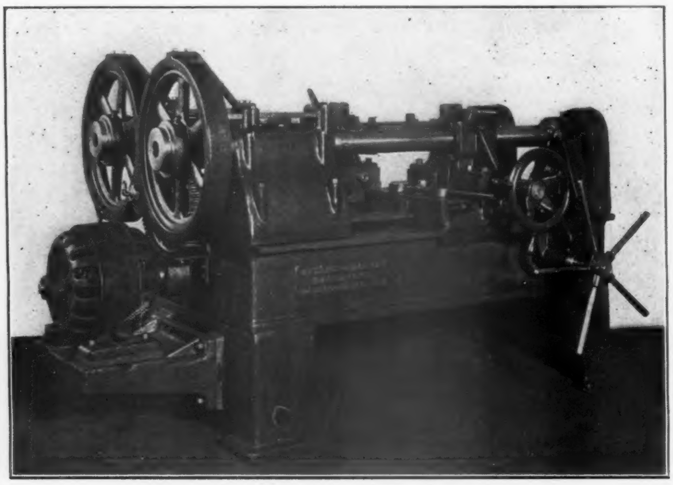
The packing is made entirely from brass, and it is claimed that it cannot be melted out by superheated steam. It is in successful use in engines having piston speeds of 1,500 ft. per minute, and also in both saturated and superheated steam locomotives. It is the invention of Thomas Smith, Apartado 279, San Luis Potosi, Mex., and has been patented by him.

DUPLEX JOURNAL BEARING BORING MACHINE

The motor driven, two spindle journal bearing boring machine shown in the illustration has been designed by Detrick & Harvey Machine Company, Baltimore, Md. This machine is constructed for heavy, rapid work, and all parts are made as simple as possible with an aim toward rapid operation and accurate results. The two boring bars and all connections are in duplicate and are mounted on a common bed of the double shear type. The bed is of sufficient length to bore and face car boxes 6 in. x 12 in. The headstocks are bolted directly to the bed and are of sufficient height to give a clearance of 13 in. from the center of the spindle bearing to the top of the bed. The spindles are of cast iron 4¼ in. in diameter with a 17 in. bearing in the headstock and carry steel tooth gears which revolve loosely on the spindles and are connected to them by sliding tooth steel clutches which are keyed to the spindle and actuated by an eccentric lever. The pinions are of bronze or steel while the driving gears are of cast iron.

Steel boring bars 3 11/16 in. in diameter are supplied for boring 5 in. diameter boxes and larger. The bars are secured to the ends of the spindles by sockets and are supported at the opposite end by bearings. These can be operated simultaneously or independently as desired.

The carriages have a sliding motion on the bed by either hand or power, and are also provided with a quick hand motion by



Journal Bearing Boring Machine; Detrick & Harvey.

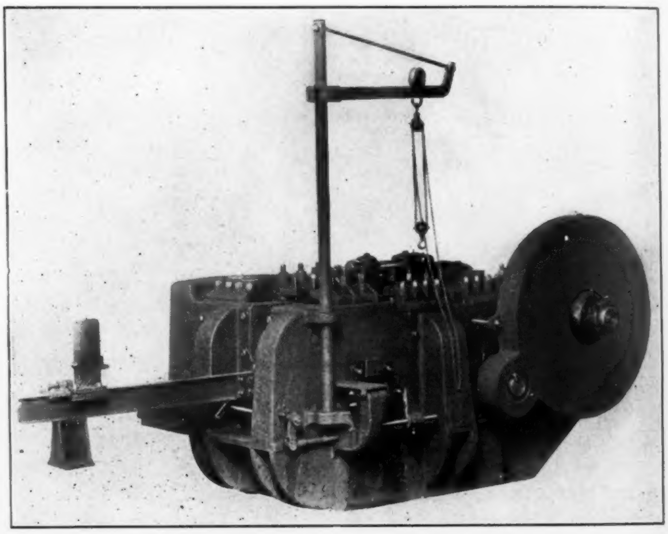
a spider to the rack. A slow hand motion is provided by a hand wheel on the end of the screw. The power feed is arranged by means of a spur gear at the end of the bed furthest from the headstock where the motion of the feed mechanism is taken from the spindles by enclosed gears. Each spindle has independent feed changes and feeds for the carriage are arranged for 1/16 in., ⅛ in. and 3/16 in. per revolution of the spindle. Each carriage carries a cross slide on which two other slides are fitted, being adjusted to and from the center line of the spindle by a right and left hand screw. The slides support the gripping jaws for holding the journal bearings and a clamp is provided at the top to prevent any springing of the parts. The carriages contain opening and closing nuts operated by a lever.

The machine is arranged to be driven by a 12½ h. p. motor which should have a speed variation between 1 and 2, giving spindle speeds from 25 to 50 revolutions per minute. The motor is mounted on a bracket attached to the machine as is shown in the illustration.

HEAVY TYPE FORGING MACHINE FOR GENERAL WORK

A new design of heavy forging machine which embodies a number of improvements and is suited for handling high carbon and alloyed steels as well as wrought iron, has been perfected by the National Machinery Company, Tiffin, Ohio. This machine is designed with a very high factor of safety and has an improved safety release on both the gripping and plunger movement.

One of the most important features of a successful forging machine of this size is the insuring of the utmost stiffness and rigidity in the frame. Especial attention has been given to this in the design illustrated, and the bed frame of the machine extends considerably below the floor line with a very heavy and

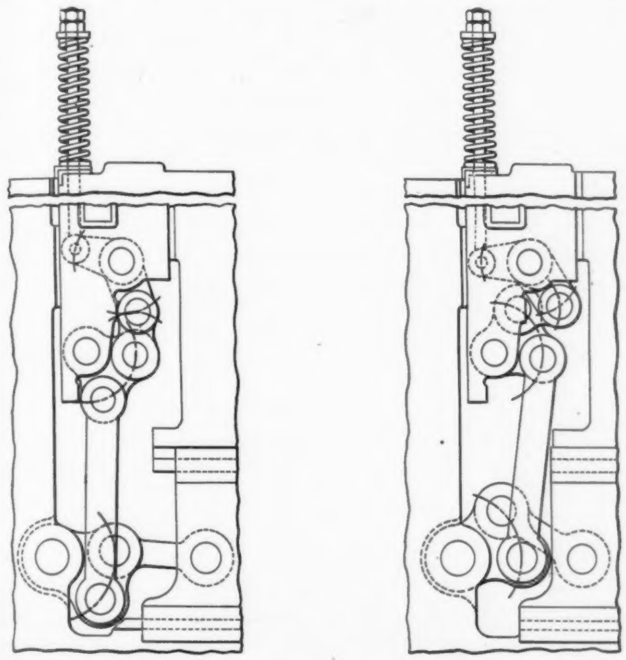


View Showing Underribbing of the National Forging Machine Frame.

massive under-ribbed or girdered portion. The whole frame is a large steel casting and efforts have been made to distribute the metal along the line of the greatest stresses to the best advantage. Sufficient success has been obtained to allow the entire elimination of tie rods which are sometimes used across the top of the bed at the gap or entrance to the dies as well as longitudinally. The massiveness of this part of the machine is well shown in the illustration.

A special design of friction fly wheel, which has proved successful in previous designs of this type of machine, is applied in this case. This, while primarily intended as a safety or relief on the plunger movement, also provides an element of elasticity and allows a motor to be connected directly to the fly wheel if desired. The motor can be geared to the fly wheel through the medium of a rawhide gear which will insure quiet operation, and experience has shown that the excessive strain thrown on the motor when the machine is accidentally stalled by cold stock or excessive metal is fully compensated and provided for by this design of fly wheel.

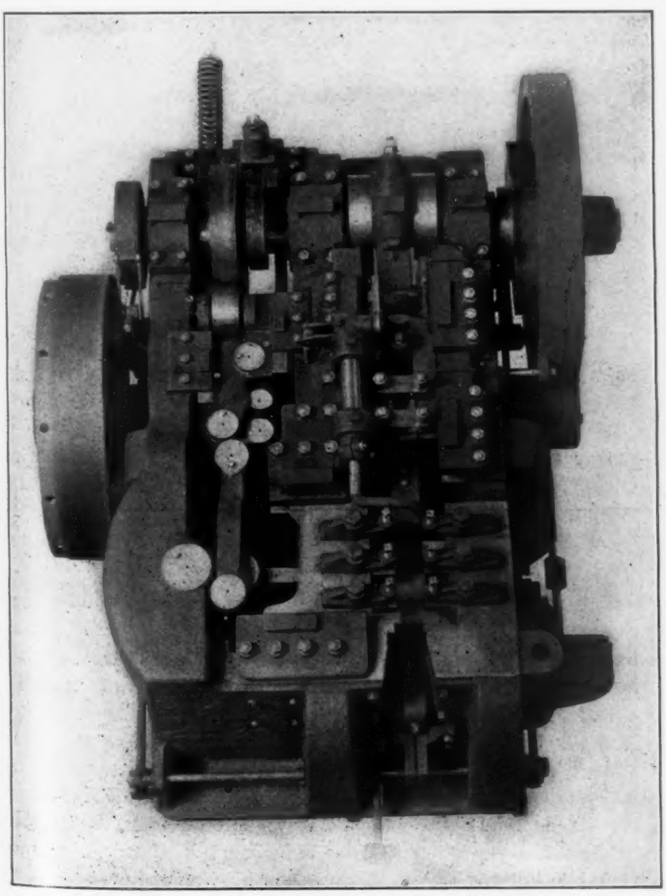
In the illustration of the top view, the four inch type of machine is shown. It will be seen that the heading movement is effected by a crank while the gripping action is controlled by two cams, one controlling the forward or gripping movement of the toggles and the other serving to open the dies. By employing two cams for the gripping movement the opening and closing of the dies is so timed as to secure practically the entire stroke of the heading tool or plunger, thus giving the machine unusually large gathering capacity, *i. e.*, ability to upset a large amount of



Normal Position. Tripped Position.

Action of Automatic Grip Relief.

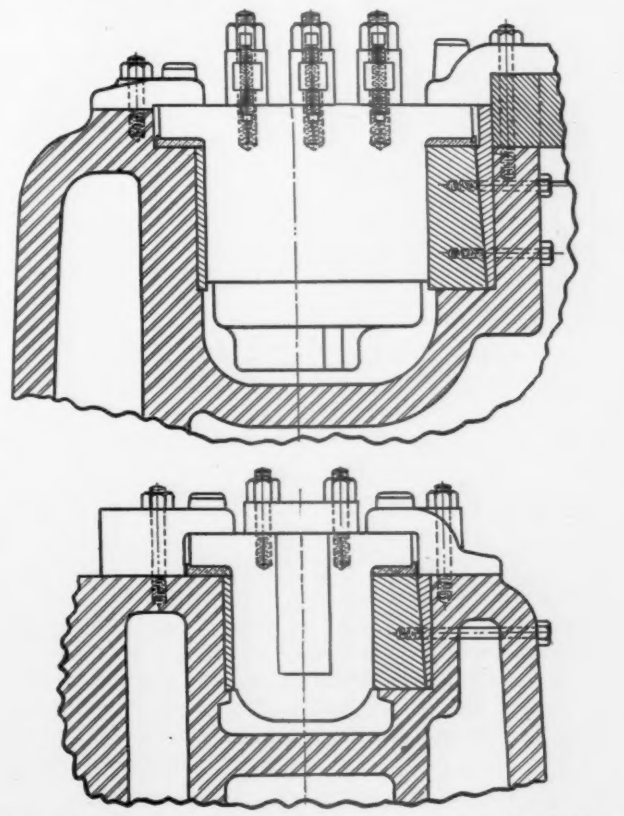
stock at one stroke of the plunger. This double cam mechanism also enables the dies to be opened wide which, with the large gathering capacity, enables the machine to handle large and difficult forgings with greater economy, as it necessitates fewer operations, and thus fewer heats, to complete the forgings, while the large die opening facilitates the handling of large upsets in and out of the machine.



General View of the National Heavy-Pattern Forging Machine.

This view also shows the automatic relief of the gripping movement. This safety device is designed in the form of a by-pass toggle, the action of which is better shown in the line drawings. It is designed so that but a small proportion of the gripping pressure or power is dependent on the toggle and the spring which holds the toggle in the normal position. This spring does not relieve the machine until the same strains are secured in the dies which in other relief designs would shear a breaker pin or bolt. The relief resets automatically without any attention on the part of the operator. Its action will be readily understood by an examination of the drawing showing it in both normal and relief positions.

Another new feature that has been incorporated is a suspended type of heading and gripping slides which are shown in section



Sectional View of the Suspended Heading and Gripping Slides.

in one of the illustrations. In this type of slide the supporting bearings are at the top instead of at the bottom which removes them from the line of water and scale that are so detrimental to lubrication. The sectional views also show the wedge construction back of the side liners on these slides. With this construction shimming can be added as needed without removing the slides or liners and it is easy to maintain a very close contact between the slide and the liner and to keep them in perfect alinement.

The slide bearings, toggle and shaft bearings are given an unusually large area in an effort to minimize wear by facilitating lubrication. The means for supplying lubricant to the various surfaces has been carefully considered and large oil boxes in the cover take care of the slides and the main shaft. Oil cups with connecting ducts are provided for the bottom toggle and other bearings. The suspended slides eliminate a source of great trouble in lubrication on many former machines.

This type of forging machine is built in sizes ranging from 2 in. to 5 in. capacity, the one shown in the illustration being the 4 in. size.

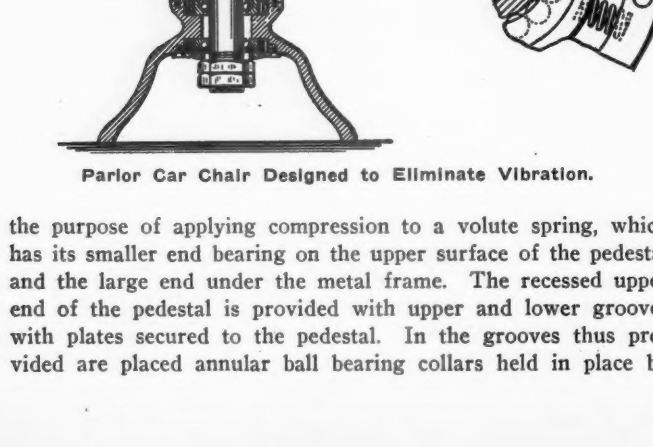
SIDE ROD GREASE PLUG

The loss of grease plugs from locomotive side rods is a cause of much annoyance and expense. The loss of a plug on the road is quite likely to permit a crank pin to heat badly before the plug can be replaced and quite frequently no spare plugs are at once vailable. The grease plug which is shown in the illustration is the invention of L. P. Welfley, Hinton, W. Va., and has been patented by him. The body of the plug is cored out and a bolt is passed through, as shown, with a taper head bearing against the sides of the plug, which are tapered to conform to the bolt head. In order to lock the plug in any position, it is only necessary to tighten up the nut on the outer end of the bolt; the same wrench can be used both for tightening this nut and for screwing down the plug in the rod. This method of locking prevents any outward movement of the plug, and therefore any slacking off of the pressure on the grease. It is claimed for this device that no injurious pressure is put on the threads and also that the cost of manufacturing the plug is quite low.

Grease Plug Showing Locking Bolt.

NON-VIBRATING CHAIR FOR PARLOR CARS

In order to reduce the vibration transmitted to passengers in parlor cars, a special type of chair pedestal has recently been devised. In the construction of this seat there is used a central shaft connected at its upper end to a metal frame, which in turn is secured to the seat frame. This shaft passes through the base, or pedestal, of the seat and has nuts on the lower end for



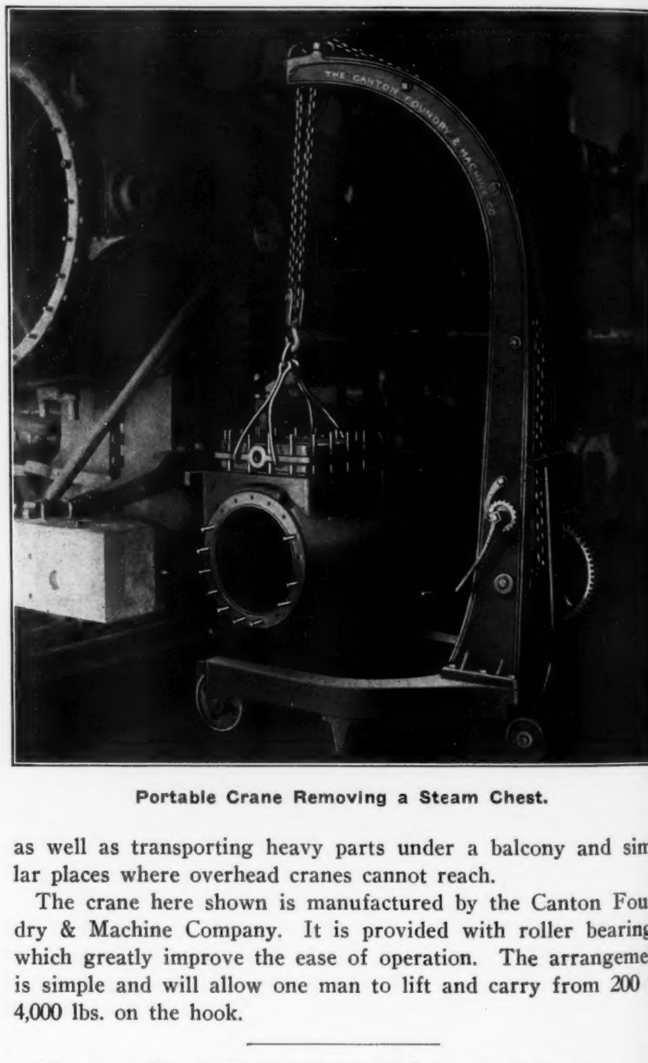
Parlor Car Chair Designed to Eliminate Vibration.

the purpose of applying compression to a volute spring, which has its smaller end bearing on the upper surface of the pedestal and the large end under the metal frame. The recessed upper end of the pedestal is provided with upper and lower grooves with plates secured to the pedestal. In the grooves thus provided are placed annular ball bearing collars held in place by springs. Any tendency to divert the shaft from the vertical is at once taken up by the shifting of the ball bearing collars, which move in opposite directions. This does not interfere with the resilient action of the volute spring.

This device was invented and patented by Henry A. Bates, Middletown, Conn., and Harold Ferrell, Plainfield, N. J.

PORTABLE FLOOR CRANE AND HOIST

The portable crane shown in the illustration has proved to be of decided value in a large number of railroad shops. The crane is shown as working in the erecting shop, where experience has proved there are a large number of operations to which it can be adapted with a very distinct saving in time and effort. In addition to this, however, it is used with advantage in the machine shop handling work to and from the machines,



Portable Crane Removing a Steam Chest.

as well as transporting heavy parts under a balcony and similar places where overhead cranes cannot reach.

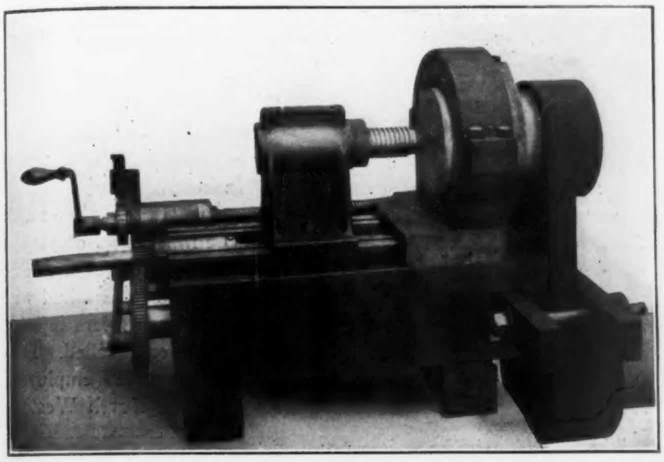
The crane here shown is manufactured by the Canton Foundry & Machine Company. It is provided with roller bearings, which greatly improve the ease of operation. The arrangement is simple and will allow one man to lift and carry from 200 to 4,000 lbs. on the hook.

Causes of Forest Fires.—The various causes of fires have not changed greatly in their relative proportions. Railroads and lightning head the list, with campers next. There has been, however, a marked decrease in the number of fires caused by burning brush, which, according to the forest officers, indicates a closer co-operation with the settlers in and near the forests and with timberland owners in fire prevention and control. It is still true, nevertheless, that a large proportion of all fires started are due to human agencies and may generally be charged against carelessness. Fires caused by lightning are of course not preventable, but the system of lookouts by which they may be detected immediately after being set is greatly lessening the loss from this source.

PORTABLE TURNING MACHINE

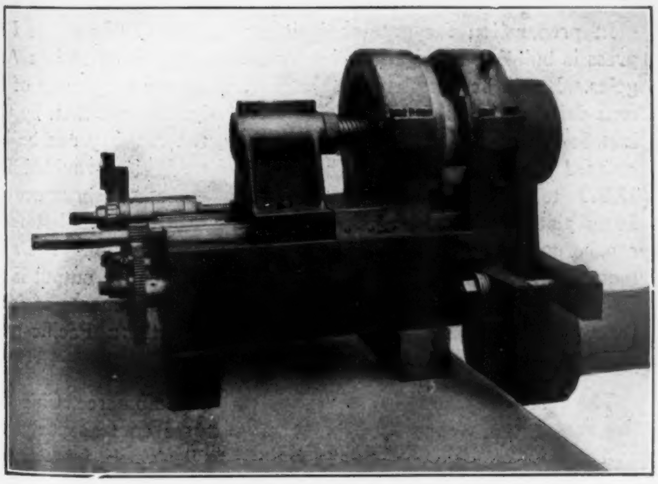
The machine shown in the accompanying illustration is intended primarily for turning crank pins in position, but is also suitable for a variety of other work where it is desired to true up a circular surface on any part of a machine without dismantling and removing it to a lathe. It is also suited for boring as well as for cutting on the outside of a shaft or pin.

It is simple in general construction, and consists of a rectangular body, planed true on all sides, which has a slot or



Portable Turning Machine Truing a Crank Pin.

opening at the front end through which a bar can be passed for clamping it to the work. The shears on which the cutter head slides are scraped and all parts are carefully fitted to give freedom of action without lost motion. The feed screw is on the far side of the bed and is actuated by a ratchet and pawl arrangement like a shaper feed which allows variable, reversible and automatic feeds to be obtained. The driving shaft is beneath the cutterhead inside the body and is supported by substantial bearings at either end. It projects beyond the

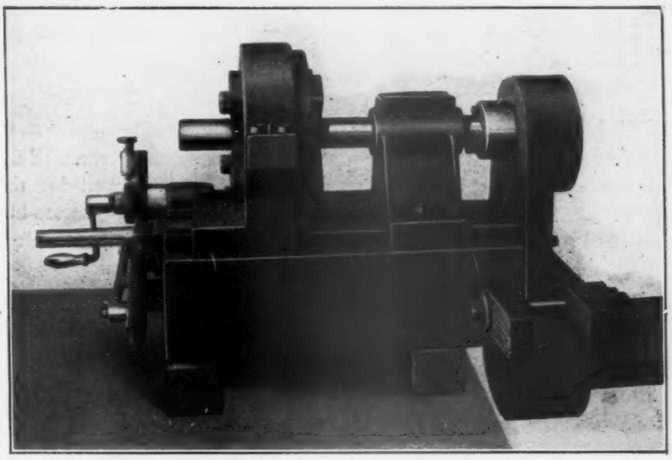


Machine Supported on the Crank Pin.

end of the bed and is arranged for driving by an air or electric motor or by a flexible shaft if there is not sufficient clearance for the application of a motor. The cutterhead is split in halves in a special manner which in no way weakens the construction and allows the machine to be used on the pins of cranked axles, driving axle journals, etc. A movable tail stock is provided and can be placed anywhere on the bed, either ahead or behind the cutterhead. It carries a centering screw with a square thread and a lock nut. When using the machine for reboring crank pin holes the tail stock is placed ahead of the cutterhead and is employed as a guide for the bar. A divided setting head is also provided which, by means of four set screws, allows the centering of the machine to be made directly from the shaft or pin itself, insuring greater accuracy, especially where the side of the crank or driving wheel is not square with the center line of the pin.

In the illustration the machine is shown truing a crank pin under conditions which permit it to be clamped directly on the wheel center. Another view shows the use of the setting head which, by means of its four set screws, allows the whole machine to be supported by the pin alone, the clamp to the crank or driving wheel being only for steadying and holding the machine in place. The third view shows it in use as a boring bar truing the crank pin hole. In this case the cutterhead is provided with clamps for holding the boring bar and the tail stock is used as a guide.

In addition to the use as a crank pin truing machine this tool is also available for truing up journals on driving axles when a wheel lathe is not available or its use not advisable. The cutterhead is arranged so that tools can be placed on either side and it can thus cut close to a shoulder on either side, as would be necessary in the case of a cranked axle. When used on a cranked axle or similar work, two tail stocks with centering bars are employed which set in deeply countersunk centers on the



Portable Turning Machine as a Boring Machine.

outside of the crank check and give the required alinement without other attachment.

The machine illustrated is manufactured by the Pedrick Tool & Machine Company, 3640 North Lawrence street, Philadelphia, Pa.

PROPOSED LINE FOR PARAGUAY.—A commission of engineers has arrived at Asuncion, Paraguay, to carry out the surveys for a line from Puerto Suarez to Santa Cruz. This line forms one of those which the Farquhar syndicate proposes to build.

RAILWAY DEVELOPMENT IN GREECE.—Discussing the reception of King Constantine in the capital the Athens newspapers say that, after the impending demobilization, the country must work at the organization of a settled administration and the development of Greece's new territories. Apart from joining up Greek railways with the European lines, the Greek system must be extended throughout the kingdom.

TRANSPORTING COAL THROUGH PIPE LINES.—A method of transporting coal by water pressure through a pipe has been suggested by E. G. Bell, engineer for the Hammersmith Electricity Works of London. By this method from 30 to 60 tons of coal per hour can, it is claimed, be forced through an 8-in. pipe leading from the Thames and under Chancellors' Road to the yard of the power plant on Fulham Palace Road, a distance of 600 yards.—*Coal Age.*

NEWS DEPARTMENT

The Great Northern and the Northern Pacific have announced that all passes issued to Montana state officers and their deputies have been revoked.

The United States district attorney at St. Louis has filed suit against the Illinois Southern to recover penalties of $8,000 for alleged violations of the hours-of-service law and for failure to report such violations.

President Daniel Willard, of the Baltimore & Ohio, has ordered that no intoxicating liquors be carried or served in his official car. President Willard aims to set an example of respect for the rules of the operating department.

James J. Hill entertained 360 members of the Veterans' Association of the Great Northern Railway, at Glacier Park, Montana, on September 16, Mr. Hill's seventy-fifth birthday. The association includes officers and employees who have been in the service of the company 25 years.

The Chicago, Milwaukee & St. Paul, the Chicago, St. Paul, Minneapolis & Omaha, the Chicago & North Western, and the Illinois Central have notified the Wisconsin Industrial Commission of their determination not to come under the state workmen's compensation law.

An appeal is made to the public by the Pennsylvania Railroad to "stop, look, and listen." That is all very well for the part of the public which goes on foot or drives milk carts, but as for the automobilists, ought not the express trains to stop, look and listen for the honk?—*Springfield Republican.*

The shops of the Trinity & Brazos Valley at Teague, Tex., including a number of cars and locomotives in the shops for repairs, were almost totally destroyed by a fire supposed to have started from an electric wire, on August 26. The loss is estimated at $225,000. It is announced that the shops will be rebuilt at once.

The Canadian Pacific has fitted up a car for giving instruction in first aid to the injured. The car, with an instructor, has been started out on a complete tour of the system, from New Brunswick to the West. It will remain at each grand divisional point for about three weeks, and at the smaller ones for about ten days.

Senator O'Gorman of New York, has introduced in Congress a bill designed to prohibit the use of wooden cars in passenger trains after a certain date in the future. The senator would make it unlawful to introduce any new wooden cars after the end of this year, and at the same time he would extend to the whole train the present rule concerning mail cars, which forbids running wooden cars between those of steel.

The Electric Division of the New York Central & Hudson River now extends on the main line from New York northward to Harmon, 33 miles, and a considerable number of through trains change engines at Harmon, instead of High Bridge, as formerly. Seven additional trains were put on this schedule recently. The northbound Empire State express, which for several years has stopped at High Bridge, now passes that place without stopping and makes a stop at Harmon.

A press despatch from Jackson, Tenn., reports that an attempt to hold up a Mobile & Ohio northbound train on the night of September 13, was frustrated by an armed guard of fifteen men who had been expecting the holdup. The bandits, who had climbed aboard the engine at a point ten miles from Jackson, jumped when the firing began and escaped into the woods, firing back as they ran. No one was wounded so far as known. The posse left the train and began a search of the surrounding country for the robbers. A farmer who lives near the scene of the holdup and who was taken into the confidence of the bandits weakened and gave the information that prevented the robbery.

R. C. Richards, chairman of the Central Safety Committee of the Chicago & North Western, has compiled a statement showing the results of the safety work for the three years ended June 30, 1913, on the basis of the number of accidents occurring during the year ended June 30, 1910. This statement shows that there was a decrease of 28.6 per cent. in the number of employees killed and 24.8 per cent. in the number of employees injured; an increase of 12.1 per cent. in the number of passengers killed with a decrease of 23.6 per cent. in the number of passengers injured, and of 18.8 per cent in the number of "outsiders" killed. During the three years from 1911 to 1913 there were 229 employees, 37 passengers and 572 "outsiders" killed on the North Western.

The New York Central is sending out a circular, to be posted in all its stations, which calls attention to the fact that about 400 persons are killed annually in the state of New York while trespassing on the railroad tracks. This is about four times the number killed at grade crossings. This notice is printed on a sheet about 8 in. x 10½ in., and is headed "DO NOT WALK ON THE TRACK." It contains the usual arguments and warnings against endangering one's life by unnecessary walking on the railroad right of way and is in type large enough to be read some little distance away. Agents are instructed to deliver a supply of the placards to the schools and also to manufacturers, shippers and others who might aid the railroad in bringing the trespassing class to their senses.

In preparation for greater fruit crops, the Pacific Fruit Express is building a large new ice manufacturing plant at Los Angeles. It will be completed in October, will have a capacity of 85 tons daily, and will cost $125,000. The design is such that, by the installation of another unit of machinery, the capacity can be increased to 170 tons daily. Storage room will be provided for 15,000 tons. The building will be of concrete construction. Icing platforms will care for 20 cars at one time, so that fruit can be moved promptly without delay in refrigeration. The ammonia condensers will be of a new type. The entire output is to be used for the rapidly increasing refrigerated shipments of fruit through Southern California and in icing Southern Pacific passenger cars at the Los Angeles station.

The North Western University School of Commerce, Chicago, has announced a course of thirty-two lectures on transportation to be given on Friday evenings from 7 to 9 o'clock, from October 1 to June 1. The course is designed to give the student a general knowledge of the transportation field as well as a detailed knowledge of the principal problems in transportation. The lectures will be given by Professor Secrist and will be grouped under the following heads: First semester, the American railway system, the railway service, the railroad and the public; and the railroad and regulation. The work of the second semester is primarily concerned with railway rates and regulation. The main topics considered are the theory of railroad rates, rate-making and practice, personal and local discriminations, freight classification, rate systems and the regulation of interstate commerce.

CHICAGO ARBITRATORS' DECISION

W. J. Jackson, F. A. Burgess and E. C. Houston, the arbitrators appointed to decide questions of wages between the Chicago & Western Indiana and the Belt Railway of Chicago, and their locomotive enginemen, have completed and handed down their report, and they hold that the roads were not justified in paying the higher wages demanded by the employees, except that they awarded an increase in the work train rate from $4.15 to $4.40 a day. Some changes in working conditions were approved. The board found that these two roads were paying higher wages than are paid by the majority of Chicago lines for the same services.

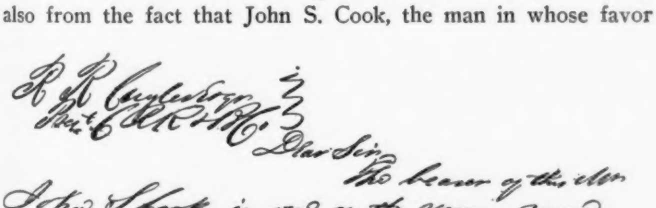
APPRENTICES ON THE NEW YORK CENTRAL LINES

The report of the apprentice department of the New York Central Lines west of Buffalo for July, 1913, gives the following figures:

	Machinists.	Boilermakers.	Blacksmiths.	Cabinet Makers and Coach Carpenters.	Tinners, Coppersmiths and Pipe Fitters.	Pattern Makers.	Painters.	Upholsterers.	Electricians.	Car Builders.	Molders.	Total.	Total Number Graduated since Jan. 1, 1912.
Beech Grove	68	8	5	1	3	4	..	..	3	3	..	95	18
Bucyrus	18	..	..	..	1	1	2	..	..	..	..	22	1
Bellefontaine	26	..	..	..	2	..	..	..	..	..	..	28	6
Collinwood	83	..	2	3	9	..	1	2	5	4	3	112	33
Elkhart	50	6	..	..	3	4	..	..	..	..	2	65	19
Gibson	13	4	..	..	..	..	..	..	..	..	..	17	2
Jackson	35	..	1	..	3	2	..	..	..	..	1	42	11
Kankakee	13	1	..	..	..	..	..	..	..	..	..	14	..
McKees Rocks...	46	2	..	..	1	..	..	..	2	1	..	52	9
Mt. Carmel	13	7	..	..	..	..	..	..	..	..	..	20	1
St. Thomas	23	3	2	..	..	1	..	..	..	..	..	29	9
Total—													
July 31, 1913....	388	31	10	4	22	12	3	2	10	8	6	496	109
June 30, 1912....	383	33	10	4	22	12	4	2	9	8	6	493	...
December 31, 1912	360	35	11	2	17	11	4	2	7	6	4	459	...
December 31, 1911	289	33	10	2	9	10	2	1	6	10	3	375	...

A LETTER OF M. W. BALDWIN

The letter dated April 3, 1849, a fac-simile of which is shown below, was written by M. W. Baldwin of Philadelphia, the founder of the Baldwin Locomotive Works. It is of interest, not alone because of the distinguished name attached to it, but also from the fact that John S. Cook, the man in whose favor


R. R. Cuyler Esqr
Prest C. R. R. Co.
Dear Sir
The bearer of this Mr John S Cook is one of the young men I have employed for years as Machinist. Mr Cook has just finished his apprenticeship at my shop & I cheerfully recommend him as a good workman as well as temperate steady & of good character & hope his employment by you will be to your mutual advantage
Yours Truly
Philadelphia
April 3 1849
M W Baldwin

it was written, was in active railroad service for about 64 years, and until a few weeks ago. The death of Mr. Cook is announced in another column of this paper.

In a letter to a friend in Philadelphia, written nine years ago, Mr. Cook explained that the reason the Baldwin letter had remained in his possession, was that one other man of a party of five presented his letter to the prospective employer and that that one had answered for the whole party. The party consisted of J. Robinson, J. R. Seeley, David Hennessey, P. Rice and Mr. Cook. Mr. Cook said that the Baldwin letter, except for the signature, was written by George Burnham, Senior.

DISCIPLINE WITHOUT SUSPENSION ON THE CANADIAN GOVERNMENT RAILWAYS

F. P. Gutelius, who was recently appointed general manager of the Canadian Government Railways (the Intercolonial and the Prince Edward Island), has issued a circular stating that it is the intention to insist on a more rigid compliance with the rules and regulations, which are made for the protection of the lives of the public and employees, as well as for the protection of the railway's property.

All employees will start with a clean record, beginning September 1. Any exceptional service rendered will be credited to the employee's record. A monthly discipline list will be issued. This list will show cause, extent of discipline, or action and extent of reward.

Employees will, as heretofore, be subject to summary dismissal for insubordination, drunkenness on or off duty, using intoxicating liquor when on duty, frequenting saloons, or places of low repute, incompetency, dishonesty, failing to carry out train orders and rules respecting train movement. Where previously discipline was meted out by suspension demerit marks will be placed in the record of an employee. For every repetition of an offence by the employee, the number of demerit marks will be doubled. When the demerit marks against any employee number 60, his services will be dispensed with.

For every 12 consecutive months good service, free from demerit marks, an employee will have 20 demerit marks deducted from those that may stand against his record. Employees will be advised when demerit marks are recorded against them, the same as they have hitherto been advised respecting disciplinary measures in the past.

MEETINGS AND CONVENTIONS

American Electric Railway Association.—The American Electric Railway Association will hold its annual convention at Atlantic City, N. J., October 13-17. Some of the principal topics to be discussed will be Unsightly Poles; Profit Sharing with Employees; The Relation of Carriers to the Development of the Territory They Serve; Relief of City Congestion; Present Tendency of Public Service Laws and Regulations; Valuation and Electric Railway Securities from the Investor's Viewpoint.

American Society of Mechanical Engineers.—The date of the railway session of the fall meeting of the American Society of Mechanical Engineers has tentatively been arranged for the afternoon of December 3. The topic for discussion will be Steel and Steel Underframe Box Cars. As the result of replies to a circular letter it has been decided to restrict the scope of the papers to secure more detailed discussion. W. F. Keisel, Jr., assistant mechanical engineer, Pennsylvania Railroad, has been asked to prepare a paper on All Steel Box Cars; and R. W Burnett, M. C. B., Canadian Pacific, on Steel Underframe Box Cars. E. G. Chenoweth (Rock Island Lines), R. B. Kendig (New York Central Lines), and B. D. Lockwood, chief engineer, Pressed Steel Car Company, Pittsburgh, Pa., have been asked to prepare written discussions on the former paper; and G. W. Rink (C. of N. J.), O. C. Cromwell (B. & O.), and A. Christiansen, chief engineer, Standard Steel Car Company, Pittsburgh, Pa., have been asked to prepare written discussions on the latter.

Pennsylvania Industrial Welfare Efficiency Convention.—The Pennsylvania Industrial Welfare and Efficiency Convention will be held in the capitol at Harrisburg, Pa., October 28-30. The convention has been called by the Hon. John Price Jackson, commissioner of labor and industry, and will consist of representatives of industrial establishments, engineers, contractors and other employers of labor doing business in Pennsylvania and representatives of labor, and heads of the various state departments coming in contact with engineering and industrial affairs of the state. The exhibit to be held in connection with the convention will be of a general engineering nature to appeal to the type of delegates attending the convention. The price for floor space will be 40 cents per sq. ft., including the standard booth, decorations, signs and reasonable amount of electric, steam, or compressed air power. These exhibits will be held in the building of the Harrisburg Railways Company, where about 26,000 sq. ft. of concrete floor space will be available. J. V. W. Reynders, vice-president of the Pennsylvania Steel Company, Steelton, Pa., is chairman of the exhibit committee.

Railway Fire Protection Association.—The proposal to establish an association for the purpose indicated by the forgoing title, which was made public some months since has now so far taken shape that a meeting for organization is to be held at Hotel Sherman, Chicago, October 7 and 8 next. Eight instructive addresses are already on the program, as follows: Charles N. Rambo, superintendent of the Mutual Fire, Marine & Inland Insurance Company, on Railroad Fires; A. D. Brooks, Illinois Central, on "Spark Hazard"; B. W. Dunn, of the Bureau of Explosives, on Handling of Explosives; N. S. Dunlop, of the Canadian Pacific, on "Causes of Fire"; Anson Murphy, Alabama Great Southern, "Construction of Buildings"; B. S. Mace, Baltimore & Ohio, on "Fire Organization," and P. Hevener, Rock Island, on "How a Locomotive May be Used to Extinguish a Fire."

W. H. Merrill, manager of the Underwriters' Laboratories, Chicago, will make some tests for the benefit of the members of the association, plans having been made for a visit to the laboratories Tuesday afternoon.

The secretary of the Committee on Organization is C. B. Edwards, fire insurance agent of the Mobile & Ohio, Mobile, Ala. Most of the members of the committee come from railroads in the southern states, but they desire to enlist the interest of all railroads; and, indeed, they have already received such assurance that they feel confident of success.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass.

AMERICAN RAILWAY MASTER MECHANICS' ASSOC.—J. W. Taylor, Old Colony building, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—A. R. Davis, Central of Georgia, Macon, Ga.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Annual meeting, December 3-6, Engineering Societies' Building, New York. Railroad session, Thursday morning, December 5.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—S. Skidmore, 946 Richmond street, Cincinnati, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, 922 McCormick building, Chicago. Convention, May 18-22, 1914, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 829 W. Broadway, Winona, Minn.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio.

MASTER BOILER MAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Old Colony building, Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOC. OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

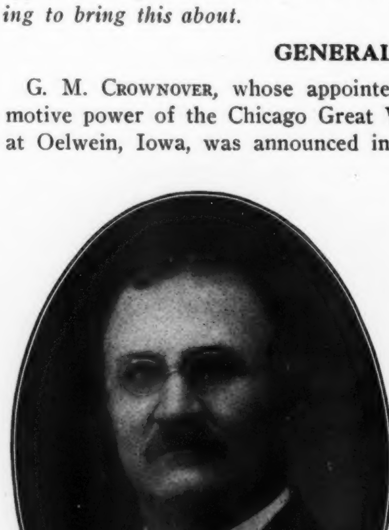
TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y.

PERSONALS

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

G. M. CROWNOVER, whose appointement as superintendent of motive power of the Chicago Great Western, with headquarters at Oelwein, Iowa, was announced in the September issue, was born September 26, 1863, at McVeytown, Pa. He graduated from the high school at Hampton, Iowa, and began railway work April 1, 1881, with the Illinois Central at Waterloo, Iowa, as machinist apprentice. After serving an apprenticeship of four years he worked two years as journeyman machinist, and in April, 1887, was made roundhouse foreman at Clinton, Ill. He remained in that position for five years, when he was transferred to Waterloo as machine shop foreman, and in October, 1896, he was promoted to general foreman in charge of the Waterloo shops. In December, 1900, he was made division foreman at Fort Dodge, Iowa, and in April, 1902, again returned to Waterloo in charge of the new shops as general foreman. Mr. Crownover was made master mechanic at Freeport in November, 1902, and two years later was transferred to Chicago as shop superintendent in charge of the Burnside shops. He left the Illinois Central in December, 1909, to become master mechanic of the Chicago Great Western at Oelwein, Iowa, which position he held until September 1, when he was promoted to superintendent of motive power, as above noted.



G. M. Crownover.

GEORGE A. HULL, acting assistant mechanical engineer of the Rock Island Lines, has been appointed assistant mechanical engineer, with office at Silvis, Ill., succeeding G. W. Lillie, promoted.

G. W. LILLIE, acting mechanical superintendent of the second district of the Rock Island Lines at Topeka, Kan., has been appointed mechanical superintendent at that point, succeeding C. M. Taylor, deceased.

GEORGE W. ROBB, master mechanic of the Grand Trunk Pacific, at Transcona, Man., has been appointed superintendent of motive power, with headquarters at Transcona, and his former position has been abolished.

C. J. STEWART, master mechanic of the New York, New Haven & Hartford, at South Boston, Mass., has been appointed assistant mechanical superintendent, with office at New Haven, Conn., succeeding H. C. Oviatt, promoted.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

B. W. ALLING, master mechanic of the Old Colony division of the New York, New Haven & Hartford at Taunton, Mass., has been appointed master mechanic of the Shore Line division, with office at New Haven, Conn., succeeding W. F. Clarkson, resigned.

W. F. BEARDSLEY, master mechanic of the Pensylvania Lines West of Pittsburgh, at Crestline, Ohio, was retired on September 1 under the pension rule of the company. The position of master mechanic of the Missouri, Kansas & Texas, at Sedalia, Mo., heretofore held by C. P. Letts, is abolished and the duties of that office will be assumed by W. Rothmeyer, road foreman of engines at that place.

J. H. DALEY, road foreman of engines of the Shore Line division of the New York, New Haven & Hartford, has been appointed master mechanic of the Old Colony division, with office at Taunton, Mass., succeeding E. W. Alling, transferred.

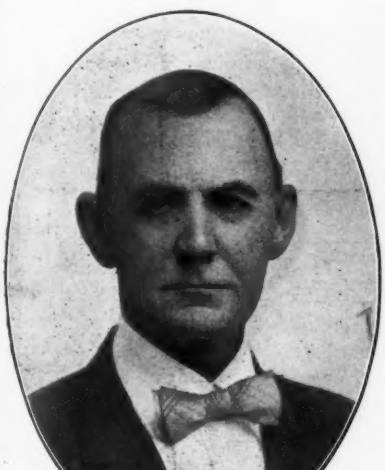
J. MCCABE, master mechanic of the New York, New Haven & Hartford at Harlem River, N. Y., has been appointed master mechanic of the New York division, with office at Harlem River.

G. A. MORIARTY, master mechanic of the New York, New Haven & Hartford at Providence, R. I., has been appointed master mechanic of the same road at South Boston, Mass., succeeding C. J. Stewart, promoted.

F. W. NELSON, general road foreman of engines of the New York, New Haven & Hartford, has been appointed master mechanic of the Western division, with office at Waterbury, Conn., succeeding C. H. Reid, transferred.

C. H. REID, master mechanic of the Western division of the New York, New Haven & Hartford at Waterbury, Conn., has been appointed master mechanic of the Providence division, with office at Providence, R. I.

J. H. WATTERS, assistant master mechanic of the Georgia Railroad, at Augusta, Ga., has been appointed master mechanic, with headquarters at Augusta, succeeding John S. Cook, deceased. He was born September 12, 1851, at Rome, Ga., and was educated in the high school of his native town. He began railway work in 1868 as a locomotive fireman on the Selma, Rome & Dalton, now a part of the Southern, and from 1871 to 1885 was locomotive engineman on the same road. He was subsequently master mechanic of the Annison & Atlantic, and then until January, 1892, was master of transportation and master mechanic of the same road and of the Anniston & Cincinnati. Both of these roads are now a part of the Louisville & Nashville. In January, 1892, he was appointed master mechanic of the Louisville division of the Louisville & Nashville, and in October, 1901, went to the Georgia Railroad as assistant master mechanic, which position he held at the time of his recent appointment as master mechanic of the same road, as above noted.



J. H. Watters.

CAR DEPARTMENT

E. L. BESHLER has been appointed car foreman of the Atchison, Topeka & Santa Fe at Cleburne, Tex., succeeding G. C. Cox.

A. COPONY has been appointed master car builder of the Western lines of the Grand Trunk, with headquarters at Port Huron, Mich., succeeding J. L. Hodgson.

JOHN L. HODGSON, master car builder of the Grand Trunk at Port Huron, Mich., has been appointed superintendent of the car department of the Grand Trunk Pacific, with headquarters at Transcona, Man. He was born in 1858 at Simcoe, Ont., and entered the service of the Grand Trunk at Brantford, Ont. In 1884 he was transferred to Toronto, as car foreman, and since 1897 has been master car builder of the same road at Port Huron.

T. W. KENDALL has been appointed car foreman of the Atchison, Topeka & Santa Fe at Newton, Kan., succeeding G. D. Wood, promoted.

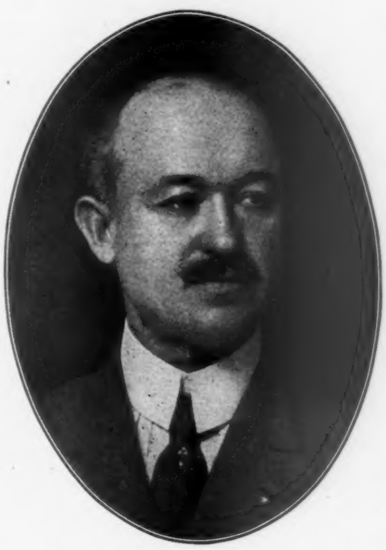
W. E. PATTERSON has been appointed foreman of the car department of the Atchison, Topeka & Santa Fe at Cleburne, Tex., succeeding G. S. Weiler, promoted.

JAMES REED has been appointed assistant division master car builder of the Lake Shore & Michigan Southern at Englewood, Ill., succeeding George Thomson, promoted.

R. W. SCHULZE, who recently resigned as general car foreman of the Gulf, Colorado & Santa Fe, at Cleburne, Tex., has been appointed superintendent of the car department of the St. Louis & San Francisco, with headquarters at Springfield, Mo.

I. S. DOWNING has been appointed master car builder of the & Michigan Southern at Englewood, Ill., has been appointed master car builder of that road, with headquarters at Collinwood, Ohio, succeeding I. S. Downing, resigned.

I. S. DOWNING has been appointed master car builder of the Cleveland, Cincinnati, Chicago & St. Louis, with headquarters at Indianapolis, Ind. Mr. Downing was born at Bentonville, Ohio, and began railway work in April, 1886, as a car cleaner for the Flint & Pere Marquette. From February, 1890, to February, 1892, he was foreman of passenger work. He then went to the Lake Shore & Michigan Southern as a car cleaner at Toledo, Ohio, and from April, 1893, to March, 1895, was an inspector at Air Line Junction, Ohio. On the latter date he was made yard foreman at that point, and in November, 1899, was advanced to general foreman at the same place. Five years later Mr. Downing was appointed master car builder of that road at Englewood, Ill., and in August, 1906, he was transferred to Collinwood, Ohio, as master car builder. He held the latter position until September 1, when he became master car builder of the Cleveland, Cincinnati, Chicago & St. Louis, as above mentioned.



I. S. Downing.

GEORGE THOMSON, assistant division master car builder of the Lake Shore & Michigan Southern at Englewood, Ill., has been appointed division master car builder at that point, succeeding J. W. Senger, promoted.

G. S. WEILER has been appointed acting general car foreman of the Atchison, Topeka & Santa Fe at Cleburne, Tex., succeeding R. W. Schulze, resigned.

George D. Wood has been appointed general car foreman of the Atchison, Topeka & Santa Fe at Shopton, Iowa, succeeding J. W. Mattey.

SHOP AND ENGINE HOUSE

C. E. Brooks has been appointed locomotive foreman of the Grand Trunk Pacific at Edmonton, Alta., succeeding W. W. Yeager, transferred.

T. W. Coe has been appointed superintendent of shops of the Lake Shore & Michigan Southern at Elkhart, Ind., succeeding W. J. Frauendiener, resigned.

W. J. Frauendiener, superintendent of shops of the Lake Shore & Michigan Southern at Elkhart, Ind., has been appointed general inspector, locomotive department, in the office of superintendent of motive power of the Cleveland, Cincinnati, Chicago & St. Louis at Indianapolis, Ind.

B. E. Hatsel, air brake room foreman of the Atchison, Topeka & Santa Fe at Cleburne, Tex., has been apopinted machine foreman at that point.

D. W. Hay has been appointed locomotive foreman of the Grand Trunk Pacific at Redditt, Ont., succeeding A. J. Roberts, transferred.

W. F. Howard, machine foreman of the Atchison, Topeka & Santa Fe, at Cleburne, Tex., has been appointed general foreman of the same road at that point.

A. H. Mahan has been appointed locomotive foreman of the Grand Trunk Pacific at McBride, B. C., succeeding A. McTavish, assigned to other duties.

A. J. Roberts has been appointed locomotive foreman of the Grand Trunk Pacific at Edson, Alta., succeeding A. H. Mahan, transferred.

Charles L. Shank has been appointed roundhouse foreman of the Atchison, Topeka & Santa Fe at Strong City, Kan., succeeding G. F. Tier.

W. W. Yeager has been appointed locomotive foreman of the Grand Trunk Pacific at Wainwright, Alta., succeeding C. E. Brooks, transferred.

PURCHASING AND STOREKEEPING

D. D. Cain has been appointed general storekeeper of the Seaboard Air Line at Portsmouth, Va., succeeding W. M. Portlock, promoted.

D. Downing, general storekeeper of the Wheeling & Lake Erie, at Ironville, Ohio, has been appointed general storekeeper of the Chicago & Alton, with headquarters at Bloomington, Ill., succeeding C. B. Foster, resigned.

W. M. Portlock, general storekeeper of the Seaboard Air Line at Portsmouth, Va., has been appointed assistant to the general purchasing agent.

R. W. Simpson has been appointed general fuel agent of the Intercolonial and the Prince Edward Island, with headquarters at Moncton, N. B.

William D. Stokes has been appointed general storekeeper of the Central of Georgia, with office at Savannah, Ga., succeeding James L. Bennett, promoted.

OBITUARY

C. M. Taylor, mechanical superintendent, second district of the Chicago, Rock Island & Pacific, at Topeka, Kan., who was granted leave of absence on account of illness in July, died on September 3, at Colorado Springs, Colo. He was born on May 25, 1862, and had been with the Rock Island since December 15, 1906, as district master mechanic and mechanical superintendent, and was previously mechanical superintendent of the Western Grand division of the Atchison, Topeka & Santa Fe at La Junta, Colo.

John S. Cook, master mechanic of the Georgia Railroad, at Augusta, Ga., died on August 28, in Johns Hopkins Hospital, Baltimore, Md. Mr. Cook had been in railroad service sixty-four years, and it is probably safe to say that previous to his last illness he was, in point of years of service, the oldest railroad officer in the United States. He was born on October 5, 1827, at Brooklyn, N. Y., and began railway work in April, 1849, as machinist in the shops of the Central Railroad at Savannah, Ga. Later he was machinist in the shops of the Georgia Railroad at Augusta. From 1850 to 1853 he was a locomotive engineer on that road; then from 1854 to 1878, about twenty-five years, he was foreman of shops. On the election of General E. P. Alexander to the presidency of the Georgia Railroad, in May, 1878, he was made master mechanic, and had held that position ever since. Mr. Cook was well known in the railroad mechanical world and was highly respected. Before entering railroad service he served an apprenticeship at the Baldwin Locomotive Works, and on leaving the Baldwin shops in 1849, he received a testimonial from Matthias W. Baldwin.

J. S. Cook.

William B. Turner, for 48 years foreman of the car shops of the Wabash Railroad at Toledo, Ohio, died recently at his home in Toledo, aged 79 years.

NEW SHOPS

McAdam Junction, N. B.—The new shops now being built by the Canadian Pacific at McAdam Junction include an erecting shop 70 ft. x 129 ft., containing six engine pits, and a machine shop 80 ft. x 129 ft. Both structures are to be of concrete and brick, with steel frames. The work, which will cost over $100,000, is already well advanced.

Railway Ties in Belgium.—Owing to the scarcity of wood in Belgium the Belgian railways are obliged to import nine-tenths of the timber used for ties, mostly from Russia.—*The Engineer.*

Wreck Statistics for 1912.—The statistical summary of vessels totally lost, broken up, condemned, etc., recently published by *Lloyd's Register*, shows that during 1912 the gross reduction in the effective mercantile marine of the world amounted to 720 vessels of 748,965 tons, excluding all vessels of less than 100 tons.—*The Engineer.*

Grenchenberg Tunnel.—The Grenchenberg Tunnel, which when constructed will be over four miles long, and will penetrate the Jura Range, has been the scene of labor trouble. The tunnel contractors are German, the engineers Swiss, the capital French, and the workmen Italian. Twice work has been at a standstill and all workmen paid off.—*The Practical Engineer.*

Supply Trade Notes

Charles N. Replogle, superintendent of the Cambria Steel Company, has been made works manager of the Ralston Steel Car Company, New York, with office in Columbus, Ohio.

Judge Carpenter, of the federal court at Chicago, has ordered the Central Trust Company, receiver, to ask bids for the sale of the Union Car & Equipment Company, West Pullman, Ill., which recently filed a petition in bankruptcy.

C. H. McCormick, for a number of years connected with the mechanical department of the Michigan Central, has been made district manager of the Standard Heat & Ventilation Company, Inc., New York, with office in Cincinnati, Ohio.

M. F. Ryan, who has been connected with the Pittsburgh Spring & Steel Company, Pittsburgh, Pa., for the past ten years, has been appointed general western sales agent of that company, with office in Chicago, in place of L. C. Noble, deceased.

W. H. Hooper, assistant to the president of the Chicago Car Heating Company, with office in Chicago, has resigned to become a vice-president of the Standard Heat & Ventilation Company, New York, with headquarters in the Peoples Gas building, Chicago.

Beaudry & Company, Inc., Boston, Mass., have perfected a direct connected motor drive for its Beaudry Champion and Beaudry Peerless power hammers, and is now arranging to carry a complete stock of motor driven hammers in addition to belt-driven hammers.

The Beaver Dam Malleable Iron Company, Beaver Dam, Wis., on Tuesday, September 16, filed a voluntary petition in bankruptcy in the federal court at Milwaukee. Liabilities are placed at $500,000, and assets at $650,000. Ernest E. Smythe, of Milwaukee, was appointed receiver.

The Philadelphia Steel & Forge Company, Tacony, Philadelphia, Pa., has just installed in the rolling mill department of its Tacony works a new power plant which will increase the output of finished bars 2,000 tons a month. This company has also installed a heat-treating plant and is specializing on high-grade steels for locomotives, machine tools, etc.

The Taylor-Wharton Iron & Steel Company, High Bridge, N. J., has opened a branch office in the Candler building, Atlanta, Ga., in charge of H. F. McDermott, as engineer and district sales manager. This office will also be a branch office of Wm. Wharton, Jr., & Co., Inc., Philadelphia, Pa.; the Tioga Steel & Iron Company, Philadelphia, and the Philadelphia Roll & Machine Company, Philadelphia.

G. S. Turner, for the last four years connected with the Crane Company, has been made second vice-president of the Chas. R. Long, Jr., Company, manufacturers of railway paints. Mr. Turner will also represent Harry Vissering & Co., having been made second vice-president of that company. His office will be at 20 West Jackson boulevard, Chicago, Ill. Mr. Turner was for more than ten years associated with the Southern Railway in the capacity of general foreman, superintendent of shops and general inspector of equipment.

A. D. Wyckoff, efficiency expert of S. F. Bowser & Co., Fort Wayne, Ind., with office at Pittsburgh, Pa., has been made eastern railroad representative of that company, succeeding Frank T. Hyndman, who recently resigned to become superintendent of motive power and cars of the Wheeling & Lake Erie. Mr. Wyckoff has been with the Bowser company for a number of years, and has had a wide experience in designing equipment for the handling and storage of oils, as well as oil filtering and circulating systems for railroads and manufacturing institutions.

The Hess Steel Casting Company, Witherspoon building, Philadelphia, Pa., has finally perfected the manufacture of the purest wrought iron material into castings. This produces castings of great density and uniformity which are particularly adapted for parts of electric equipment where high magnetic permeability is essential and also for purposes where castings have to withstand corrosion, high pressure and high temperatures associated with excessive cooling and heating, such as case hardening boxes, etc. Any required alloy can be introduced in this same raw material, producing excessively high tensile strength or hardening qualities as required.

Announcement is made that the entire capital stock of the Putnam Machine Company, Fitchburg, Mass., has just been purchased by Manning, Maxwell & Moore, Inc., New York. The Putnam Machine Company is the pioneer machine tool manufacturer of the country, and was started in 1836 by Salmon W. and John Putnam. The plant now covers about fourteen acres. S. W. Putnam, son of the founder, and his son, S. W. Putnam, 3d, will retain their connection with the company, which will retain its name and be operated on its own identity. The following are new directors of the company: Salmon W. Putnam, Alfred J. Babcock, John N. Derby, Percy M. Brotherhood and George D. Branston.

Charles W. Allen, a vice-president and a director of the L. J. Bordo Company, Philadelphia, Pa., has been made manager of the railway department of the Reading-Bayonne Steel Castings Company, with office in Reading, Pa. Mr. Allen received his education in the Tamaqua schools and served an apprenticeship as machinist in the Tamaqua shops of the Philadelphia & Reading. After several years he was made engine house foreman at Milton, where he remained six years. In 1904 he was transferred to Reading as master mechanic of the Reading and Harrisburg division. He resigned this position on January 1, 1907, to become railroad representative of the L. J. Bordo Company. In 1908 he was made a vice-president and director of that company, which position he retained until his appointment as manager of the railway department of the Reading-Bayonne Steel Castings Company, as mentioned above.

Ernest F. Slocum, formerly vice-president of the Safety Car Heating and Lighting Company, New York, has returned to that company as assistant to the president, a position which has not been filled for some time. Mr. Slocum was born in Newark, N. J., in 1870, and spent his boyhood days in St. Louis, Mo., where he received his early education. He started his business career as a journalist, and was connected with the New York *Herald* and the *Commercial Advertiser*, also of New York. Later he was made director and manager of the *Daily Advertiser* of Newark, N. J. In 1895 he went to the Safety Car Heating & Lighting Company, accepting a position offered him by the late Colonel A. W. Soper. In May, 1907, he was made a vice-president of that company, having charge of sales. In October of that year he suffered a nervous breakdown and has been out of business up to the time of his appointment as assistant to the president of the Safety company, as mentioned above.


Ernest F. Slocum.

CATALOGS

SWITCHING LOCOMOTIVES.—Bulletin No. 1015 from the American Locomotive Company, New York, includes tables of dimensions of twenty-four recent designs of switching locomotives of the 0-6-0, 0-8-0 and 0-10-0 types. Most of these engines are also illustrated by means of photographs.

MOTORS.—A new bulletin from the General Electric Company describes its adjustable speed, direct current motors. These are especially designed to meet the requirements of individual drive for machine tools. The bulletin illustrates these motors and their application in considerable detail and contains various curves showing the horse power output at various speeds.

RAILROAD ELECTRIFICATION.—The Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., is issuing two leaflets covering the electrification of the New York extension of the Pennsylvania and that of the New York, New Haven & Hartford. These leaflets cover the salient points of both systems and give a description of the apparatus used. A map showing the territory covered by both of the electrified systems is included.

STEEL PLATES AND BARS.—A leaflet from the Carbon Steel Company, Thirty-second street, Pittsburgh, Pa., briefly lists the sizes and forms of plates and bars which it is prepared to furnish. Some of the special steels manufactured by this company are briefly described and their special uses mentioned. A table giving the various uses of steels and the recommendations of this company for the quality most suitable for each, occupies several pages.

STARTERS FOR A. C. MOTORS.—A detailed description of an automatic starter for alternating current motors is found in the bulletin just issued by the General Electric Company, Schenectady, N. Y. Automatic control panels for squirrel cage induction motors and slip ring induction motors, as well as float switches for remote control of automatic starting panels or rheostats and pressure governor panels, also for remote control, are described in this bulletin.

PUNCHES AND SHEARS.—The Oeking solid steel frame combination machines will cut a plate, cut and miter an angle and punch without the necessity of changing tools, and all on the same machine. These machines are illustrated together with various other types of smaller size for regular and special uses. The catalog is issued by the Wiener Machinery Company, 50 Church street, New York.

MALLEABLE CASTINGS FOR AIR BRAKE EQUIPMENT.—Catalog No. 22, National Malleable Castings Company, Cleveland, Ohio, is designed for use in ordering brake levers, brake lever pins, brake lever connecting rods, dead lever guides, hose clamps and other castings used in connection with air brake equipment. In each case the part is shown by a photographic reproduction and a line drawing with lettered dimensions, and the accompanying table gives the ordering number and sizes.

DRAWING INSTRUMENTS AND MATERIALS.—A very complete illustrated catalog and price list of drawing and tracing papers, blue printing paper and equipment, drawing instruments and materials, surveying instruments and accessories, etc., is being issued by Kolesch & Company, 138 Fulton street, New York. This book is complete in every particular and lists every appliance or apparatus that is used by a draftsman or surveyor. It contains 336 pages and is fully indexed.

ELECTRIC WELDING.—A very interesting and instructive discussion of the electric arc for welding will be found in Bulletin No. 513-C from the C. & C. Electric & Manufacturing Company, Garwood, N. J. This bulletin discusses the advantages of this form of welding and where it can be used, the method of producing the arc, description of the apparatus needed and how it operates, the kind of welding materials to use, etc. A large number of illustrations of locomotive and machine tool repairs made in this manner are included.

WRECKING HOOK.—A leaflet from the National Malleable Castings Company, Cleveland, Ohio, illustrates and briefly describes the Goodman Wrecking Hook which has proven its value by constant use for a number of years and on many of the larger railway systems. This hook can be quickly attached to any design of M. C. B. Coupler, having either solid or slotted knuckle, and is made amply strong for its intended uses while at the same time the design has been so carefully worked out that it is light enough to be readily handled by one man. It is made of high-grade open-hearth steel.

RAILWAY EQUIPMENT.—The Orenstein-Arthur Koppel Company, Koppel, Pa., have had over 40 years' experience in the building and developing of industrial and narrow-gage railways of every description in various parts of the world. This company is prepared to study and make recommendations for individual transportation problems of all kinds. A comprehensive catalog is being sent out illustrating and briefly describing the large variety of products which it is prepared to furnish. These comprise rails, portable track, switches, turntables, cars, steam and electric locomotives, etc.

BAR IRON, BOLTS AND NUTS.—The Kansas City Bolt & Nut Company, Kansas City, Mo., has rolling mills which have an annual capacity of 40,000 tons. Its products are merchant bar iron in various sizes and forms, as well as bolts and nuts which are made from the iron coming from its own mills. Catalog No. 813 fully lists all of these products, showing track bolts, machine bolts, blank bolts, carriage bolts, lag screws, etc. Prices are included in most cases. This company is also equipped for producing forgings in large quantities, and the catalog illustrates and mentions a number of railroad forgings that it is prepared to furnish!

GALVANIZING EQUIPMENT.—A pamphlet issued by the Metal Treating & Equipment Company, United States Rubber Company Building, New York, contains a brief treatise on the protection of iron and steel against corrosion. It discusses the causes of corrosion and the methods that are generally accepted and used for its prevention. It describes how the galvanizing or other protecting means act and the difficulties introduced in their use. A description is included of the equipment furnished by this company for galvanizing and instructions on how to figure for the required size of equipment that may be desired for a special purpose.

RAILWAY MOTOR CARS.—Motor cars in several sizes and arrangements are illustrated in a catalog being issued by the Chicago Pneumatic Tool Company, Fisher Building, Chicago. The catalog contains some actual figures on the cost of operating these cars both for section and inspection work. An electric signal bonding outfit consisting of a single cylinder, 4 cycle gasolene engine, direct connected to 1¼ K. W. generator wound for 125 volts, all of which is mounted on a welded steel frame and carried on a four-wheel truck is also described. This is arranged to allow the use of electric drills in the drilling of holes for signal bonding on steam railroads.

STEEL BARS, WIRE AND FORGINGS.—In its latest catalog the Philadelphia Steel & Forge Company, 50 Church street, New York, announced that it has reconstructed its mills and shops, installed the most modern machinery and equipment to meet the most exacting requirements, and that it is prepared to manufacture all grades of crucible and open hearth steels, both carbon and different alloys in bars, strips, forgings and forged and rolled shapes. The company makes particular mention of its specialty department, which is devoted exclusively to high-grade steel, such as tool steel, automobile steels, alloy steels, etc. The catalog lists and briefly describes the special characteristics of all of these products and is illustrated by photographs of the new plant.